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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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The B.C.I.R.A. Scottish Laboratories are :—
Foundry Technical Institute, Meek's Road, Falkirk (*Telephone* 332)

Forthcoming Events.

DECEMBER 8.

Institute of Marine Engineers:—Ordinary meeting in London. "Nickel and Nickel Alloys in Marine Engineering," Paper by J. McNeil.

Sheffield Metallurgical Association:—Ordinary meeting. "The Fuel Problems of the Metallurgist," Paper by H. Clifford Armstrong.

Institute of British Foundrymen.

DECEMBER 10.

Lancashire Branch (*Burnley Section*):—Ordinary meeting at Burnley. "Modern Foundry Practice and Developments," Paper by J. Masters.

Birmingham, Coventry and West Midlands Branch:—Ordinary meeting. "Modern Application of Sand-Blast Plant," Paper by T. Fearnley Allen.

DECEMBER 11.

London Branch:—Annual Dinner in London.

DECEMBER 12.

Wales and Monmouth Branch:—Ordinary meeting at Cardiff. "Foundry Work in India," Paper by G. Morgan.

West Riding of Yorkshire Branch:—Meeting at Bradford. General discussion on Foundry Problems.

Newcastle-upon-Tyne and District Branch:—Ordinary meeting. "Heat-Resisting Alloys," Paper by J. Ferdinand Kayser.

Scottish Branch:—Ordinary meeting. "An Engineer's View of the Foundry," Paper by Henry Gardner. Also Annual Dinner.

East Midlands Branch:—Ordinary meeting at Nottingham. "Cast Iron, from the Ore to the Casting," Paper by P. A. Russell, B.Sc.

Welding and Workmanship.

A contemporary has recently given some particulars of an important report issued by the American Bureau of Welding, as a result of several years' investigation on the influence of skill in the art of welding. We have in these columns from time to time indicated sufficiently well that the welding process is one which offers great possibilities to the founder, and is not one to be regarded altogether as competitive. We therefore shall not be accused of criticising the welding process in showing that this report has ascertained in effect what many engineers have felt as a result of experience, for many years, without having had the precise statistical data to go upon.

The report shows the importance of the human element; that good welding can only be produced by good welders. It may equally be said that good castings can only be produced by good moulders, but the traditional founding process has resulted in the existence of skilled moulders, whereas the welding process is too new to have created such a reservoir. Just as the development of machine moulding is modifying the skill of the craftsman moulder, so the welding industry looks to welding development to replace the skill of the welder, so as to ensure a more uniform and homogeneous product.

In the American tests it was found that welders with eight years' experience produced welds ten per cent. better than those with only three years' experience. A selected group of over thirty men showed a difference of over 20 per cent. between the best welds and the worst. Again, taking the work of carefully-selected welders, it was found that a welded joint may have a strength of within about 12 per cent. of an average figure. Presumably this is above or below the average, yielding a total variation of nearly a quarter of the average strength. We admire the courage of the welding industry of America in publishing these figures, and we think a statement of the facts and the willingness to face them is the first step towards overcoming the difficulty.

Those who are attempting to replace castings by weldings might well ponder on the variations in strength demonstrated to exist at the welded joint in a material of uniform thickness, before criticising the inevitable variation in strength with thickness in a casting.

At one time variations of this magnitude may have existed in castings, but the placing of metal mixtures under metallurgical control has resulted in a very marked improvement and diminution of the difference between the strength of thick and thin sections. We may reasonably look forward to the day when it will be possible to make a casting having its thick sections virtually as strong as the thinner ones.

The B.I.A.

The British Ironfounders' Association is working very hard to attain a 100 per cent. membership of their organisation of firms making light castings for the building industry. They consider, and rightly so, that this is a prerequisite to the re-establishment of the industry on a profit-paying basis.

We are not at all sure that the provisional agreement which has been prepared and is ready for completion as soon as it is felt that all key foundries are signed up, should be the one and only selling point. After all, one has to sell a membership just as one has to sell a packet of cigarettes or a wireless set. We are convinced that the provisional agreement is the cardinal selling point, but ancillary advantages such as statistical services; standardisation; unified costing; unified tax allowances; rail freight agreements; territorial zoning; international cartellisation; technical help; tariff negotiations; research are all well worthy of stressing. We can readily appreciate that there is probably a distinct desire not to cloud the major issue, but some of these minor points are considered as of outstanding importance by certain of our friends in the light-castings industry.

The British manufacturer is inherently an individualist, and a veritable broadside of selling points has to be brought to bear to induce him to co-operate. Whilst we would reiterate that no doubt every aspect has been placed before the non-associated members, we feel that there are a few generalisations which could be usefully stressed as to possible future developments in a disorganised light-castings industry. Foreign firms may construct new foundries in England having the latest and best plant money and brains can devise. The blast-furnace people may decide to emulate their Continental competitors, utilising the cheapness of their raw materials and absence of transport costs to enter the light-castings market. Both these eventualities can be more adequately dealt with if the light-castings industry is in a position to speak with one voice.

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Electric *versus* Cupola Iron.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I was very pleased to see your valuable criticism attached to my article of November 12 issue. The article is controversial, I know, but I venture to suggest that it is all the more interesting for that, inasmuch as it may have the effect of drawing attention to a very important subject, and consequently we may get other people's ideas on the matter.

With regard to your comments, I must apologise for certain sins of omission in the article in question. For instance, in the comparative strengths of electric and cupola cast iron, I should have stated that the analysis of the two samples was almost identical except in the matter of the sulphur, which in the electric, of course, was much lower. The actual analyses were as follow:—

Electric.—T.C., 2.70; Si, 2.20; Mn, 0.55; S, 0.02, and P, 0.40 per cent.

Cupola.—T.C., 2.77; Si, 2.35; Mn, 0.47; S, 0.063, and P, 0.38 per cent.

I do not claim to have anything but a very elementary knowledge of moulding practice, but as far as I know I do not think the difference in the cost of moulding the two irons was very appreciable. Of course, the test-pieces for comparison were taken from similar places and cast in a similar manner. The machinability of the electric iron was found to be much better than that of the cupola product, due to the absence of hard spots.

As regards keeping the iron hot enough to cast a 20- or 30-ton job, I have often cast as much as 80 tons in one pouring, and finished up with a ton or two of very small castings.—Yours, etc.,

WALTER LISTER.

Mansfield.
November 22, 1931.

[As we suspected, the class of iron detailed, both cupola and electric, owing to the low T.C., would, in general, involve enhanced moulding costs, compared with normal grey iron foundry costs.—EDITOR.]

MINING & INDUSTRIAL EQUIPMENT, LIMITED, 11, Southampton Row, London, W.C.1, report the receipt of the following new orders: For Australia, a Raymond pulveriser for grinding hydrated lime; for Rangoon, a No. 3 "Impax" pulveriser; for Rhodesia, an 8-ft. by 60-in. Hardinge ball mill, for grinding lead-zinc ore.

NEW GOVERNMENT CONTRACTS listed in the "Ministry of Labour Gazette" include the following:—Admiralty: J. Stone & Company, Limited, London (manganese bronze); Aluminium Corporation, Limited, London (aluminium sheets). War Office: H. Gardner & Company, Limited, Swansea (nickel); Stewarts & Lloyds, Limited, Halesowen, and Mucklow Bros., Limited, Birmingham (pipes and fittings); Hadfields, Limited, Sheffield (bullet-proof plates); Thos. Firth & John Brown, Limited, Sheffield (steel bars); Jonas & Colver (Novo), Limited, Sheffield, and the Langley Forge Company, Birmingham (medium-tensile steel); Dorman, Long & Company, Limited, Middlesbrough (mild-steel sheets); Hadfields, Limited, Sheffield, and Colvilles, Limited, Motherwell (nickel-chrome steel). Crown Agents for the Colonies: Guest, Keen & Nettlefolds, Limited, London (dogspikes); Cochrane & Company, Limited, Middlesbrough (pipes); Tangyes, Limited, Birmingham (pumping plant); Cargo Fleet Iron Company, Limited, Middlesbrough, and the Barrow Hematite Steel Company, Limited (rails and fish-plates); United Steel Companies, Limited, Sheffield (steel bars); British (Guest Keen Baldwins) Iron & Steel Company, Limited, London (steel sleepers); Anderston Foundry Company, Limited, Middlesbrough, and the Darlington Railway Plant & Foundry Company, Limited (switches and crossings); Stewarts & Lloyds, Limited, Birmingham (tubes).

Notes from I.B.F. Branches.

The London Junior Section met last Friday in the offices of THE FOUNDRY TRADE JOURNAL, when Mr. A. F. Gibbs (Past-President of the London Branch) read a practical Paper, illustrated by lantern slides, on "The Manufacture of Locomotive Cylinders." This Paper was presented before the Senior Branch some years ago. Mr. L. H. Howell, the chairman, presided.

West Riding of Yorkshire.—The meeting on December 12, at the Bradford Technical College, will be open for the discussion of members' foundry problems. The President has invited members to submit problems to the secretary in advance in order that the discussion may be well ordered and constructive.

The Preston Section of the Lancashire Branch will hold its first general meeting in the Technical College, Corporation Street, Preston, on Wednesday, December 9, at 7.30 p.m. Mr. W. West (Farington Steel Foundry, Leyland Motors, Limited) will give a talk on "Foundry Problems and their Solution," the aim of the lecture being to give practical assistance to foundrymen in their differing classes of work and at the same time outline the basic principles which must be observed to obtain successful results.

The honorary secretary of the new Section is Mr. P. Leyland, of 6, Ashley Terrace, Farington, near Preston.

The Microscope in Metallurgy.

The Wales and Monmouth Branch of the Institute of British Foundrymen met on November 20, under the chairmanship of Mr. R. J. Richardson, at the University College, Cardiff, to hear an address by Prof. Read on the use of microscope in metallurgy. The lecture was couched in the simplest of language, and dealt with the preparation of specimens, including polishing and etching. Then he illustrated the methods of mounting, coarse and fine adjustments, and concluded by likening the freezing of metals and alloys to salt solutions with a view of giving some elementary notions of internal structures as revealed by the microscope.

Who Makes It?

At this time of changing business outlook, it seems desirable to call attention to service we give privately, unless of real public interest. For instance, our outgoing mail to-night carries four letters telling of the source of supply of certain types of nails, of a make of core-blowing machine, of an annealing-stove charging machine, and of carbon electrodes. In all these cases, so far as we can judge, the inquiries are due to the departure from the gold standard, and, maybe, the incidence of tariffs. We ask any foundry to consult us where they find that the changing conditions require advice as to the source of supply.

A Stanton Service Development.

The Stanton Ironworks Company, Limited, near Nottingham, having acquired a financial interest in Wilson Bros. (Pipe Fittings), Limited, of Bridgeton Foundry, Glasgow, have entered into a working arrangement whereby the Glasgow works will be utilised by Stanton for assisting in dealing with Scottish orders, and also for enabling the Stanton Company to carry a varied stock of their standard sand-cast and De Lavaud spun iron pipes, and specials, for Scottish requirements.

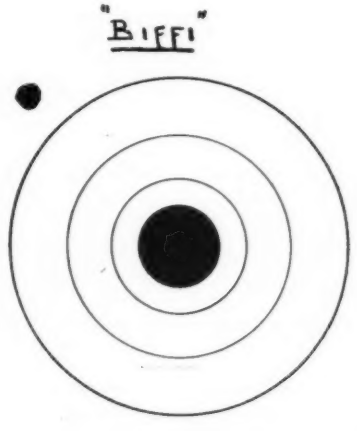
Random Shots.

The reading matter contained in diaries is not of a type calculated to provoke unseemly laughter. But in the compendium of a diary issued by the National Union of Commercial Travellers is a statement which strikes me as being unconsciously humorous—from a founder's point of view. In Birmingham, "the special times to be avoided" by travellers are the Iron-Masters' quarterly meetings! These are ranked with such other varied events as cattle fairs, orange celebrations, race weeks and wakes—all terribly bad for business.

* * *

Before Christmas arrives, the statue of Eros will have been returned to the original site in Piccadilly Circus. Of aluminium, and cast just off the Tottenham Court Road, the casting has had, for a statue, a mobile career. Banished for some years to the Embankment Gardens, Eros was championed magnificently by a band of stalwarts whose "agitations" have led to its replacement in the Circus. The beauty of the work merits so prominent a position. And it will be all the more appreciated since, in the city's high places, so many statues which are not, have stood unmoved and unmoving for years. The Victorian political giants, brilliant though they were, in Roman togas are not the least bit decorative.

* * *



'A BAD SHOT'

EXTRACT FROM CORRESPONDENCE.

* * *

"Marksman" may occasionally miss his target, according to his illustrated correspondence, but for a complete "outer," he awards this week's booby prize to the Bulletin of one of the foreign foundry associations which credits Dr. Norbury with having read a scientific Paper way back in 1830. Substantiation forthcoming, he ought to forsake metallurgy and collaborate with the monkey gland merchants.

* * *

Sir Robert Hadfield, F.R.S., who celebrated his 73rd birthday over the week-end, has just written a most fascinating account of Michael Faraday and his metallurgical researches, "with special reference to their bearing on the development of alloy steels." Faraday was in a happy position in those days; there was then no demand for the properties of which his steels were capable.

MARKSMAN.

Further Experiments on Oil-Hardening and Air-Hardening Cast Irons.*

By J. E. Hurst.

In the previous Paper† the author described the results of some investigations into the properties of alloy cast irons of the nickel-chromium type, after hardening and tempering. It was shown that certain compositions of nickel-chromium cast irons can be hardened and tempered to develop higher ranges of Brinell hardness. When hardened and suitably tempered, the strength properties: the ultimate breaking strength, modulus of elasticity, area of stress-deflection curves, are definitely satisfactory. Probably one of the most important results disclosed by this investigation was the definite increase in strength, to a value exceeding the original "as-cast" condition, associated with hardening and tempering at a suitable temperature. From this point of view, it appeared advisable to continue the experimental work by investigating other types of cast iron. The whole of these further investigations have been conducted with centrifugally-cast material, and the experimental and testing methods adopted were identical with those described in the previous Paper.

It is of interest to study the behaviour of cast irons containing no nickel. For this purpose, two samples have been chosen, of which the analyses are given in Table I. Sample No. 1 is a plain cast iron, free from nickel or chromium, of the type complying with the requirements of Air Board Specification 4K6 for piston rings. Sample No. 2 is a cast iron of similar type, but containing a small addition amounting to 0.41 per cent. of chromium. For comparison purposes, a nickel-chromium cast iron has been included in the series, sample No. 3.

The test results obtained on specimens from these materials are set out in Tables I to VI. In each case the results show the same characteristics as those disclosed in the previous investigation. Quenching in oil is accompanied by a sharp rise in the hardness value and a sharp drop in the ultimate strength. The En value also is decreased by the hardening treatment. Tempering at increasing temperatures brings about a sharp recovery in the strength values, the maximum being attained with a tempering temperature from 300 to 350 deg. C. The hardness values undergo a decrease which steepens sharply with the higher tempering temperatures. As in the previous cases recorded, the En value varies somewhat irregularly, although there is a tendency to recover in value. The maximum ultimate strength attained in each case exceeds substantially this value of the material in the "as-cast" condition.

It is of interest to observe that the plain cast iron without alloy additions responds to both the hardening and tempering treatment and that tempering is accompanied by the rise in ultimate strength to a maximum value higher than that of the original "as-cast" condition. The Brinell hardness values on the standard test-rings are incomplete, in that the nickel-chromium samples were not examined. The hardness values on the thicker rings of half-inch square section are complete. It will be noted, in all cases where they can be compared, that these are lower than the corresponding values on the standard test-rings. The values are lower by a substantial amount, indicating a marked sensitivity in these specimens to the effect of mass and rate of cooling in quenching.

In attempting to compare these values, it will be observed that the nickel-chromium iron shows the lower results on hardening. This is due probably to the lower combined-carbon content of this material, for the most part. The values for samples of this material after tempering are not lowered greatly, and they compare favourably with these for the other two materials. The plain chromium sample gives the highest hardness values, both after hardening and after tempering, up to a temperature of 500 deg. C. In the case of the plain unalloyed cast iron, the hardness tends to fall off more rapidly with tempering than in the other two cases.

The Effect of Hardening Temperature

The effect of hardening temperature on the results obtained from oil-hardening and tempering has been investigated. The series of results selected to demonstrate the kind of results obtained are taken from an essentially chromium alloy cast iron containing no nickel developed specially by the company with which the author is associated. The extremely high hardness and strength values obtained with the material are of special interest. The results are tabulated in Table VII. As in the previous examples, the results are determined on standard test-rings. The hardness determinations are taken by means of the Firth Hardometer utilising the diamond indenter and a load of 30 kgs.

The hardness and strength values for the "as-cast," hardened and tempered conditions for each hardening temperature are illustrated dia-

TABLE I.—*Composition of Materials Used.*

Sample number.	Description.	Composition.								
		T.C.	C.C.	Gr.	Si.	Mn.	S.	P.	Ni.	Cr.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	Plain cast iron	3.30	0.62	2.68	2.3	0.87	—	0.71	Nil	Nil
2	Chromium cast iron	3.36	0.65	2.71	2.23	0.57	—	0.41	Nil	0.41
3	Nickel-chrome cast iron ..	3.39	0.44	2.95	2.25	0.63	—	0.37	2.44	0.51

TABLE II.—*Brinell Hardness of Samples using 10-mm. Ball 2,000 Kgs. for "As-Cast" Specimens and 1,000 kgs. for Hardened Specimens.*

Material.	Specimen number.	1	2	3	4	5	6	7	8	9	10	11
Plain cast iron ..	As-cast	195	195	202	202	214	214	214	202	214	214	220
	Hardened 875 deg. C. in oil	390	276	429	390	429	429	429	357	390	390	429
Chromium cast iron	As-cast	220	214	202	214	214	220	228	228	228	242	234
	Hardened 875 deg. C. in oil	474	390	429	474	474	400	429	474	429	—	—
Nickel-chromium cast iron	As-cast	228	202	208	208	208	208	214	214	228	228	228
	Hardened 875 deg. C. in oil	395	395	395	395	395	400	395	395	395	395	—

TABLE III.—*Brinell Hardness Determinations on Tempered Test-Rings, half-inch square cross section.*

Tempering temperature.	Brinell hardness, 10-mm. ball 2,000 kgs.							
	100 deg. C.	250 deg. C.	300 deg. C.	350 deg. C.	400 deg. C.	450 deg. C.	500 deg. C.	600 deg. C.
Plain cast iron	390	390	357	327	327	312	276	268
Chromium cast iron	390	390	390	357	342	342	300	240
Nickel-chrome cast iron	390	357	357	342	312	300	288	276

TABLE IV.—*Plain Cast Iron, Standard Test-Rings.*

Condition.	Elasticity En value. Lbs. per sq. in. × 10⁶.	Tensile strength. Tons per sq. in.	Brinell-Firth diamond hardness 120 kgs. load.
As-cast	16.3	18.4	230
Normalised at 630 deg. C...	15.0	16.75	230
Hardened in oil from 875 deg. C.	15.0	10.8	518
Tempered at 100 deg. C.	15.5	11.9	534
,, 250 deg. C.	17.0	21.5	488
,, 300 deg. C.	17.1	23.0	488
,, 350 deg. C.	17.9	21.2	460
,, 400 deg. C.	13.6	17.65	412
,, 450 deg. C.	16.2	18.6	401
,, 500 deg. C.	15.0	17.6	320
,, 600 deg. C.	16.2	17.6	291

TABLE V.—*Chromium Cast Iron, Standard Test-Rings.*

Condition.	Elasticity En value. Lbs. per sq. in. × 10⁶.	Tensile strength. Tons per sq. in.	Brinell-Firth diamond hardness 120 kgs. load.
As-cast	15.0	20.4	245
Normalised at 630 deg. C...	16.4	23.2	250
Hardened in oil from 875 deg. C.	14.3	11.3	551
Tempered at 100 deg. C.	12.4	10.4	587
,, 250 deg. C.	16.6	21.6	518
,, 300 deg. C.	16.4	22.5	488
,, 350 deg. C.	16.4	19.6	—
,, 400 deg. C.	15.1	21.0	435
,, 450 deg. C.	15.7	23.3	412
,, 500 deg. C.	15.0	19.8	335
,, 600 deg. C.	15.1	20.2	—

TABLE VI.—*Nickel-Chromium Cast Iron, Standard Test-Rings.*

Condition.	Elasticity En value. Lbs. per sq. in. × 10⁶.	Tensile strength. Tons per sq. in.
As-cast	16.65	22.1
Normalised at 630 deg. C. ..	13.35	18.3
Hardened in oil from 875 deg. C.	14.85	11.35
Tempered at 100 deg. C. ..	13.4	10.70
,, 250 deg. C. ..	12.6	16.3
,, 300 deg. C. ..	17.0	29.8
,, 350 deg. C. ..	14.5	24.1
,, 400 deg. C. ..	13.7	18.3
,, 450 deg. C. ..	18.2	30.0
,, 500 deg. C. ..	15.2	21.1
,, 600 deg. C. ..	14.0	20.0

* Paper presented to the Sheffield Branch of the Institute of British Foundrymen on November 20, Mr. G. C. Castle (Branch-President) presiding.

† FOUNDRY TRADE JOURNAL, December 4, 1930.

grammatically in Figs. 1 to 4. The high hardening temperature of 920 deg. C. is accompanied by definitely inferior results to the lower hardening temperatures, both as to hardness values, ultimate strength values and recovery of ultimate

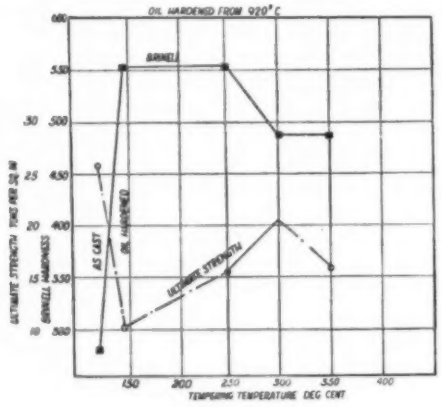


Fig. 1.

strength values after tempering. The recovery to a maximum ultimate strength value with a tempering temperature of 300 deg. C., however, still persists.

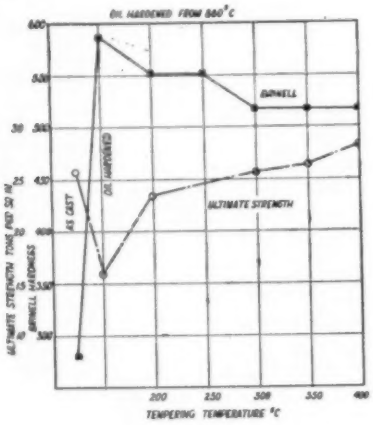


Fig. 2.

The hardening temperature of 860 deg. C. maintains a high level of hardness and ultimate strength. In this case the recovery to a maximum value occurs with a higher tempering temperature of 400 deg. C. The lower quenching temperatures of 830 and 800 deg. C. both maintain the high level of hardness and tensile strength. The recovery to a maximum value takes place at a slightly lower tempering temperature of about 350 deg. C. in both cases. The lowest tempering temperature results in an exceptionally high recovery of ultimate strength from 26.5 tons per sq. in. to a maximum of 30.5 tons per sq. in., a gain of over 15 per cent.

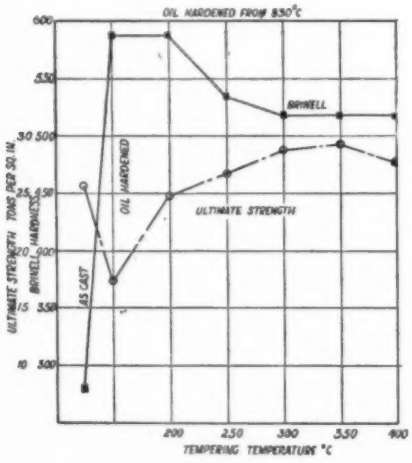


Fig. 3.

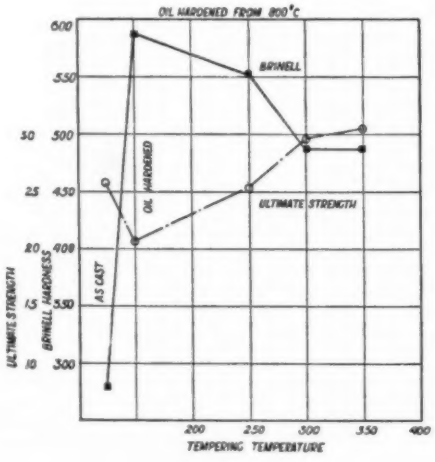


Fig. 4.

The Effect of Mass on Specimens.

The difference in the hardness determination on the ring samples of ½-in. sq. section in Table III and those obtained on the standard test-rings has already been noticed. The following experiment has been conducted on 2-in. dia. bars 6 in. long. The bars were cast in permanent metal moulds by the method in vogue at the author's works. The chemical composition of the specimens is given in Table VIII:—

Table VII.

Sample.	Treatment.	Brinell hardness.	Elasticity. En value. Lbs. per sq. in. × 10^6.	Tensile strength. Tons per sq. in.	Modulus of rupture. Tons per sq. in.	Permanent set. Per cent.
1	As-cast	278	17.3	26.5	42.6	7.95
2	Oil-hardened from 920 deg. C.	551	16.3	10.5	16.9	—
3	Do. Temp. 250 deg.	551	17.3	15.7	25.3	1.50
4	Do. Temp. 300 deg.	488	16.6	20.1	32.4	1.52
5	Do. Temp. 350 deg.	488	16.1	16.1	25.9	1.67
6	Oil-hardened from 860 deg. C.	587	17.0	16.75	27.0	4.35
7	Do. Temp. 200 deg.	551	16.4	23.5	37.9	2.86
8	Do. Temp. 250 deg.	551	15.9	24.0	38.7	2.74
9	Do. Temp. 300 deg.	518	17.0	25.7	41.5	2.9
10	Do. Temp. 350 deg.	518	17.2	26.5	42.6	1.51
11	Do. Temp. 400 deg.	518	17.4	28.3	45.6	0.62
12	Oil-hardened from 830 deg. C.	587	15.8	17.3	27.8	6.2
13	Do. Temp. 200 deg.	587	16.0	24.8	40.0	2.86
14	Do. Temp. 250 deg.	534	17.3	26.5	42.6	2.82
15	Do. Temp. 300 deg.	518	16.9	28.8	46.5	1.64
16	Do. Temp. 350 deg.	518	16.3	29.3	47.2	1.50
17	Do. Temp. 400 deg.	518	16.6	27.8	44.8	2.78
18	Oil-hardened from 800 deg. C.	587	16.3	20.9	33.7	4.2
19	Do. Temp. 250 deg.	551	16.5	25.3	40.7	1.45
20	Do. Temp. 300 deg.	474	17.7	29.2	47.1	1.43
21	Do. Temp. 350 deg.	518	17.1	30.5	49.2	1.50

Brinell hardness determinations were made by means of the Firth Hardometer using the diamond indenter. Starting from the outside end of the specimen, fifteen impressions were made at approximately regular intervals across the section of each bar to the centre of the bar. The results obtained in the "as-cast" and hardened condition in the case of specimens of the above materials are tabulated in Table IX and illustrated diagrammatically in Figs. 5 and 6.

These results present several features of interest. In the first place they reveal an effect in the "as-cast" condition which must be attributed to the nickel and chromium present. The effect referred to is the uniformity of the Brinell hardness from the outside edge to the centre of the specimens. This is shown on the diagram, Fig. 5. The somewhat irregular distribution of the hardness in the ordinary material and the uniform hardness of the nickel-chromium samples is clearly shown. The diagram also shows the increased hardening effect of the alloy additions. It is also of general interest to refer to the lower Brinell hardness towards the outside edge of the specimen of ordinary material. This is a characteristic feature of bars cast in hot metal moulds. It will be observed also that the alloy cast-iron bars which were likewise cast in hot metal moulds do not show any increase in hardness at the external surface of the specimens. All the bars were tested in the "as-cast" condition without any annealing.

Table VIII.—*Composition of Bars Used.*

	T.C. Per cent.	C.C. Per cent.	Gr. Per cent.	Si. Per cent.	Mn. Per cent.	P. Per cent.	Ni. Per cent.	Cr. Per cent.
Material.								
Ordinary	3.41	0.52	2.89	2.26	0.65	0.68	Nil	Nil
1 per cent. Nickel chrome	3.55	0.55	3.00	2.18	1.10	0.70	0.97	0.38
2 per cent. Nickel chrome	3.58	0.59	2.99	2.20	1.05	0.71	1.98	0.32

In the hardened condition the same order of difference in hardness is preserved, the higher nickel-content sample showing the highest values. This sample shows also completely regular hardness values from the external edge to the centre of the specimen. The lower nickel-content sample shows a distinctly less hardening effect and this penetrates uniformly into the specimen for a distance of half an inch only. Beyond this the hardness value falls off rapidly to the centre of the specimen.

The specimen of ordinary material is hardened to a very slight degree only by this treatment, and the distribution of the hardness is very irregular. This experiment shows that in the thicker sections ordinary material of this composition does not harden readily by quenching in oil. The presence of the alloy constituents nickel

and chromium increases the hardening capacity by this treatment. The effect of increased quantity of nickel in increasing the penetration

TABLE IX.—*Brinell Hardness of Materials in Table VIII.*

Before and after hardening by quenching in oil from 875 deg. C.

Material.	Ordinary.		1 Per cent. nickel chrome.		2 Per cent. nickel chrome.	
Condition.	As-cast.	Hard-ened.	As-cast.	Hard-ened.	As-cast.	Hard-ened.
Outside edge.	241	291	286	335	302	460
	241	291	286	335	302	460
	255	278	286	335	302	460
	255	278	286	335	302	460
	269	291	286	335	302	460
	269	291	286	335	302	460
	269	278	286	335	302	460
	269	291	286	335	302	460
	269	291	286	320	302	460
	255	278	286	320	302	460
	255	278	286	291	302	460
	255	278	286	291	302	460
	255	255	286	291	302	460
	241	255	286	278	302	460
	228	245	286	255	302	460
Centre	228	245	286	255	—	—
	—	255	—	—	—	—

of the hardening effect in addition to increasing the magnitude of the effect is the outstanding demonstration of this experiment.

Air-Hardening Material.

The experimental results obtained from a nickel-chromium iron with the presence of con-

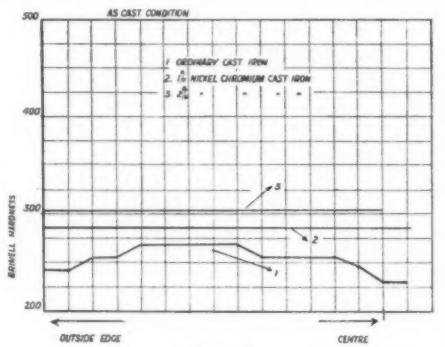


FIG. 5.

siderable quantities of manganese and silicon are of interest. These results are summarised in Table X. The cast irons are similar in character to the sample G.8 in the previous Paper,‡ but with the addition of slightly more silicon and

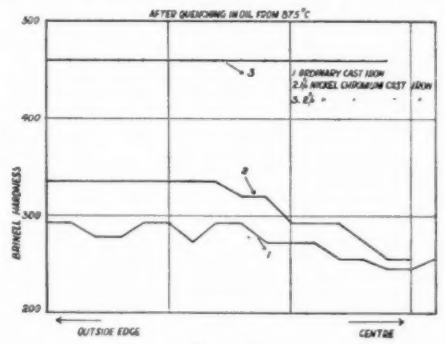


FIG. 6.

over 2 per cent. of manganese. The specimens were treated in various ways; normalised, air-hardened from 875 and 800 deg. C., oil-quenched from 875 and 800 deg. C. and quenched in molten salts (Quenchoid) standing at 150 deg. C. from the same temperatures. The hardness results demonstrate clearly that this material possesses distinct air-hardening properties in addition to oil-hardening properties. The higher hardening temperature of 875 deg. C. is accompanied by more positive results. With quenching in molten salts from 800 deg. C. practically no hardening effect is obtained, but this treatment is accompanied by quite a distinct increase in tensile strength over both the air-hardening and oil-hardening treatments. From a temperature of 875 deg. C. quenching in molten salts yields a distinct hardening effect and the tensile strength is maintained at a higher level than the other hardening methods.

The effect of normalising treatments on these specimens is of interest and significance. These treatments appear to smooth out the slight irregularities in hardness and yield in all the specimens a uniform hardness value. They are also accompanied by a noticeable increase in En value and tensile strength, and a noticeable decrease in permanent set value.

Summary.

(1) The results of further experiments on the heat-treatment of cast iron by air-hardening, oil-hardening and tempering have been recorded. In all cases, except where specially mentioned, the experimental work has been conducted on standard ring-form specimens complying with the dimensional requirements of B.E.S.A. Air Board

TABLE X.—*Properties of Heat-treated Cast Irons.*

ANALYSES: Pot No.	T.C.	Gr.	C.C. by diff.	Si.	Mn.	Ni.	Cr.
65	3.49	2.76	0.73	2.80	2.26	1.04	0.57
66	3.47	2.65	0.82	2.71	2.20	—	—

Sample No.	Pot No.	Treatment.	Brinell hardness.		En value. Lbs. per sq. in. × 10^6.	Tensile strength. Tons per sq. in.	Modulus of rupture. Tons per sq. in.	Permanent set.
			As-cast.	Treated.				
1	65	As-cast	235	—	13.4	18.3	—	14.3
12	65	,, ...	226	—	13.7	17.3	—	—
23	65	,, ...	226	—	14.2	18.0	—	—
19	65	Normalised at 500 to 550 deg. C. ..	235	226	—	—		
24	65	,, ,, ,, ..	235	226	15.28	19.3		7.6
25	65	,, ,, ,, ..	235	226	—	—		
26	65	Normalised at 700 to 750 deg. C. ..	235	226	14.0	18.5		10.2
27	65	,, ,, ,, ..	226	226	—	—		—
28	65	,, ,, ,, ..	226	226	—	—		—
29	65	,, ,, ,, ..	226	226	—	—		—
2	65	Air-hardened from 875 deg. C. ..	226	412	12.69	9.68		
5	65	,, ,, ,, ..	245	423	—	—		
8	65	,, ,, ,, ..	226	412	—	—		
11	65	,, ,, ,, ..	226	412	—	—		
14	65	,, ,, ,, ..	226	423	—	—		
6	65	Air-hardened from 800 deg. C. ..	235	352				
16	65	,, ,, ,, ..	235	352				
4	65	Oil-hardened from 875 deg. C. ..	245	460	12.08	9.81		
7	65	,, ,, ,, ..	235	460	—	—		
10	65	,, ,, ,, ..	226	460	—	—		
13	65	,, ,, ,, ..	226	460	—	—		
17	65	,, ,, ,, ..	235	435	—	—		
3	65	Oil-hardened from 800 deg. C. ..	226	412				
20	65	,, ,, ,, ..	226	412				
15	65	Quenched in Quenchoid at 150 deg. C.	235	235				
22	65	Do. from 800 deg. C.	217	226				
9	65	Do.	235	226				
18	65	Quenched in Quenchoid at 150 deg. C.	245	291	—	—		
21	65	Do. from 875 deg. C.	226	371	13.07	10.73		
1	66	As-cast	226	—	12.2	14.8		
12	66	,, ...	226		17.6	17.3		
19	66	Normalised at 500 to 550 deg. C. ..	235	226				
2	66	Air-hardened from 875 deg. C. ..	235	352				
5	66	,, ,, ,, ..	226	352				
8	66	,, ,, ,, ..	226	352				
11	66	,, ,, ,, ..	226	390				
14	66	,, ,, ,, ..	235	390				
6	66	Air-hardened from 800 deg. C. ..	217	352	12.8	17.0		13.1
16	66	,, ,, ,, ..	226	352	—	—		—
4	66	Oil-hardened from 875 deg. C. ..	217	460				
7	66	,, ,, ,, ..	226	460				
10	66	,, ,, ,, ..	226	460				
13	66	,, ,, ,, ..	235	460				
17	66	,, ,, ,, ..	245	488				
3	66	Oil-hardened from 800 deg. C. ..	201	412	11.28	14.0		
20	66	,, ,, ,, ..	241	412	—	—		
18	66	Quenched in Quenchoid at 150 deg. C.	226	226	—	—		
21	66	Do. from 800 deg. C.	255	226	14.5	22.3		10.8
22	66	Quenched in Quenchoid at 150 deg. C.	255	390				
9	66	,, ,, ,,	226	460				
15	66	Do. from 875 deg. C.	235	371				

‡ *Loc. cit.*

Specification 4K6. Whilst this form of specimen has been largely used, it is essential to point out that in practice these heat-treatments are applied to cylinder castings and to various forms of general castings.

(2) In suitable thin sections plain unalloyed cast iron is capable of being hardened by oil-quenching from suitable temperatures. In a like manner, plain chromium irons are capable of being hardened, and the presence of nickel is not necessary to obtain the hardening effect.

(3) In suitable thin sections the plain chromium iron appears to be accompanied by a higher level of hardness values than the nickel-chromium iron, and the hardening effect is more stable on tempering.

(4) In thicker sections it has been shown that an ordinary cast iron is not very susceptible to hardening by quenching in oil. The presence of alloy constituents, nickel and chromium, increases the hardening capacity. In these thicker sections nickel has the effect of increasing the depth of penetration of the hardening, and appears to have the effect of increasing the degree of hardness obtainable.

(5) A high hardening temperature of 920 deg. C. is accompanied by definitely inferior results, both as to hardness and strength values after hardening and tempering, in the samples experimented with. The lowest quenching temperatures tend towards the best results.

(6) In all cases the effect of hardening is accompanied by a loss of strength properties, and in all cases these are recovered and reach a maximum value definitely higher than the "as-cast" value after tempering.

(7) The behaviour of the materials in respect of En value is somewhat irregular after hardening and tempering.

(8) The properties of an iron containing no nickel have been described, showing the high value of hardness, strength and En value, and the low value of permanent set which can be maintained after hardening and tempering.

(9) The development of air-hardening properties in a nickel-chromium iron by the addition of manganese has been shown, and the effects of normalising on the hardness and strength values have been shown to be advantageous in making the initial hardness more uniform and slightly improving the strength properties.

(10) The effect of quenching in molten salts at 150 deg. C. in the case of the samples investigated has been shown to be accompanied by a slightly higher strength value after hardening and prior to tempering, and a slightly lower hardness value.

In conclusion, the author wishes to acknowledge his indebtedness to Sheepbridge Stokes Centrifugal Castings Company, Limited, for permission to publish these results, which have been determined in their research laboratories, and also to the Editor of The Foundry Trade Journal for the help in the provision of diagrams.

Birmingham Electric Furnaces, Limited, announce that they have entered into an agreement with the Electric Furnace Company, of Salem, Ohio, providing for an interchange of technical information, designs and patent rights. Birmingham Electric Furnaces, Limited, now have the rights of the American company's patents in Europe and the British Dominions, whilst the Electric Furnace Company have the rights of "Birlec" patents in the United States and Canada. By another agreement Birmingham Electric Furnaces, Limited, have the patent rights in Europe and British Dominions of C. I. Hayes, Inc., Providence, R.I., U.S.A., respecting their "Certain Curtain" method of atmosphere control. This method enables the heating of high-speed and other steels to be effected without scaling or decarburisation. These arrangements refer only to technical information and patent rights, and do not affect, in any way, the administration of Birmingham Electric Furnaces, Limited, which retains its own individuality as a British concern, producing a British-made furnace.

Foundry Selling Practice.

By Eric N. Simons.

(*Continued from page* 323.)

No. 11. THE SALESMAN'S VADE-MECUM.

One of the first principles in the successful selling of any commodity is the provision of information to representatives. But however copious, accurate and informative the odd pamphlets and notes a sales department circulates among its sales force, the mere provision of the information will not of itself be sufficient. The data supplied must be used. A salesman should be able to answer, within reason, any question asked him by his customers. How are his hydraulic cylinders tested? What tensile strength has his manganese steel? What is the composition of his aluminium alloy? The asking of questions at an interview means that the customer is interested. If the representative has to admit ignorance and refer the matter to the works, time is lost and interest may fade. The salesman many be unable to follow up the foundry reply immediately. The order may, therefore, be lost.

Yet it is unreasonable to expect a salesman, however able, to carry in his head masses of facts and figures on the offchance that he may at some time or other be asked for them. Equally unreasonable is it to ask him to carry about perpetually a collection of odd memoranda, catalogues, letters and notes containing this information. Some representatives of the more energetic sort will, of their own accord, make for themselves little data books, gathering together into compendious form odd items they think may be useful to them. But each representative will collect different data. The sales manager will never be sure how far the facts and figures recorded are accurate and up to date, and there is a possibility that important things will be missing.

Yet the possession of information being essential, the difficulty must be overcome, and the best method of overcoming it is the provision, by the sales department, of a proper vade-mecum for all its representatives. This should consist of loose leaves, accurately indexed and numbered, bound up conveniently in little black loose-leaf binders. The form of these binders is important and should be carefully studied. The binder should be small enough to slip into an inside pocket, so that the representative has no reasonable excuse for not carrying it with him. The binding device should be simple and easy of operation, preferably of a type that the binding-posts or strips are not sharp-edged and do not cut the paper.

The sales department should next collect together, all on sheets of standard size, and typewritten for preference, and duplicated (if the quantity warrants it) on a duplicating machine, condensed data for the use of its representatives. One may now examine the type of data that should be included in a book of this kind.

First and foremost come standard basis prices for all the products of the firm. Next, standard conditions of supply; lists of extras (if any), special reservations, etc. The next section should deal with analyses, where there is no objection to these being revealed. Following this, a section of great use is one on mechanical characteristics, *e.g.*, tensile strengths, elongations, standard measurements, weights, etc. In this section also should be included particulars of any treatments to which the castings should be subjected, results of tests, *e.g.*, resistance to corrosion, attack by acid, destruction tests and so forth. It need scarcely be said that all this information will have to be carefully condensed and presented in a form curtailed to the greatest possible extent. Economy of arrangement is the great desideratum, as it prevents the book from becoming bulky, enables more data to be put on to a page and enables the representative to find more easily what he requires.

A further section of inestimable value is one consisting of useful general data, *e.g.*, tables for the calculation of weights, conversion tables for foreign measures into English and *vice versa*, temperature conversion tables, simple formulæ and methods of calculation, Brinell hardness tables, and any similar standard data that can be of service to the representative either during or after an interview.

Thus far the sales vade-mecum consists primarily of technical or practical material. Some sales departments go farther than this. In their belief, the book should also contain summarised talking points for all the various products. There is a good deal to be said for this, as it enables the representative with a large number of different goods to sell to familiarise himself before an interview with the strong arguments in favour of the line he is going to discuss. Some sales departments also summarise the arguments of competitors, so that representatives shall see how to meet these.

From time to time, prices, facts, analyses, etc., alter. Not a moment should be lost in at once preparing a set of revised sheets, sending these out to the holders of the books, and ensuring that they substitute the revised sheets (which should, of course, bear the correct numbers) for the ones already in their books that are now obsolete. Thus, if page 7 becomes obsolete, the page prepared to take its place should also be numbered page 7.

The final question concerns the holders of these books. Throughout this article the representatives have been spoken of as those for whom they are designed. This is so; but in actual practice the word "representative" has a wide meaning. The chief draftsman, the foundry manager, the production engineer, the buyer, the sales manager, the publicity manager, any official of the firm who has, from time to time, to go out of the works and meet customers, actual or potential, becomes for that period his company's representative. Since anything may arise in conversation, and even enthusiastic publicity managers have been known to come back with orders, each and every one of these officials should be provided with the vade-mecum. With it in his possession he will never be caught napping. He will be able to answer questions. And the very possession of the book with its implications will give him a greater interest in trying to push the reputation and advantages of his firm's manufactures than he otherwise would have had. This is all to the good.

(*To be continued.*)

British Standards Institution.—During recent years the British Engineering Standards Association has prepared British standard specifications and established British standards not only for use in the engineering field, but also for a growing range of materials in the building, chemical and textile industries. The need for regularising this extension of the original functions of the Association has been under consideration from time to time, and became imperative when the chemical industry invited the Association to widen its scope to include chemical standardisation generally. The building industry also desired a substantial extension of the work of standardisation within that industry and urged that the title of the Association should be more in conformity with the wideness of its scope. It was therefore decided to re-organise the work of the Association into four main divisions of equal standing, responsible for the preparation of British standard specifications in the engineering, chemical, building and textile industries, each of the four divisions being under the control of a representative divisional council. The Council, therefore, applied for, and have been granted a supplemental Royal Charter, authorising these changes. In future the name of the Association will be the "British Standards Institution" and its activities will be under the control of a General Council which will have under it the four Divisional Councils.

XUM

High-Strength Sand-Casting Aluminium Alloys.

By W. C. Devereux.

(*Concluded from page* 335.)

Temperature Control.

Temperature control of the melting and pouring is as important as the correct disposition of the runners and risers. The metal for the 4 to 5 per cent. Cu alloy and particularly for "Y" alloy, should not be allowed to exceed 750 deg. C. in the furnace; with the R.R. 50 alloy it is safe to go up to as high as 820 deg. C., but, of course, this high temperature is never necessary. The pouring temperatures must be accurately controlled, and always the same for each casting; temperatures from 690 deg. C. for heavy work, to 740 deg. C. for thin parts, being the limits in the case of "Y" alloy, but occasionally one might find that one could cast much thinner parts in the case of R.R. 50 alloy and go up to 770 deg. C., remembering that low temperature decreases contraction during solidification. Stewing of the metal at all costs should be avoided, the mould always being made ready for the metal. In the case where several pots are required to pour a large casting, the practice of using an ingot of material to hold back a pot of metal is unsatisfactory; a better method, and one used personally, is to use a square of Ni-Cr steel—about 14 lbs.—screwed in the end of a steel rod; it is a much more satisfactory method, and several pots can be controlled to a few degrees. A good method of pyrometer control is to have the indicators enclosed in boxes on posts distributed about the foundry, with two thermo-couples attached, and a throw-over switch so that one is a check on the other, and one man only reads, probably 20 yds. from the mould, he advising the actual man pouring when the temperature is correct. The detail points in these metals, as in all foundry work, are the ones that make or mar success. It is a good thing to provide a special furnace for heating pouring pots to receive the metal, and not relying on placing the pots on the melting furnace to warm them.

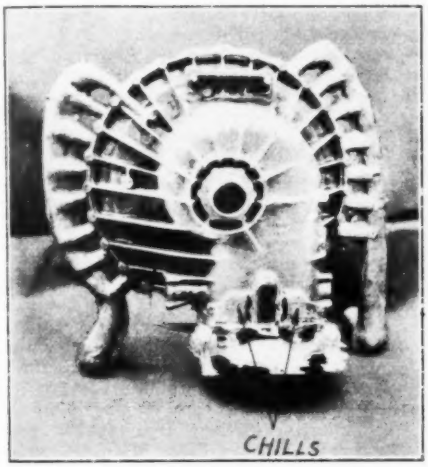


FIG. 15.—A SUPERCHARGER CASTING FOR WHICH ONLY SIX CHILLS ARE USED.

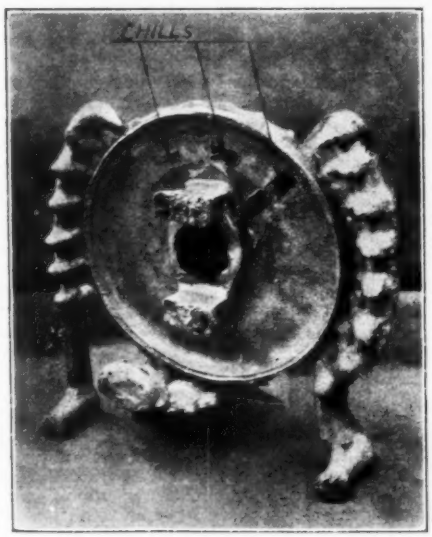


FIG. 16.—THE TOP FACE OF THE CASTING SHOWN IN FIG. 15.

Practical Details.

In the use of the metal, the Ti-addition in the R.R. 50 certainly acts as a deoxidiser and cleanser, and it is safe to use good heavy scrap, and runners and risers up to 60 per cent. or even more; but in the case of "Y" alloy extreme care must be taken in the case of ingot and scrap to ensure gas-free metal; it is unsafe to use more than 20 per cent. of works scrap and then only the cleanest of material if good results are to be obtained. The sprues should be kept full during pouring and the metal handled as quietly as possible, pouring in an unbroken stream from a low height. As to sand, any of the usual moulding sands, similar to Red Mansfield, are suitable, and should be used with very little new sand, a small quantity being added occasionally to open the sand a little.

All moulds may be green or skin-dried for heavier work. The same sand is used for core work, and it is the author's practice to add a little sea sand to the floor sand, about one bucketful of sea sand to three barrow loads of floor sand. Of course, cores are stove-dried. In the case of delicate cores, the author uses 30 parts of sea sand to one of linseed oil base binder. The use of vents and wax tapers should be very carefully studied to see that vents definitely join up and lead out of the mould. The principle may be adopted that, however much one vents, one cannot vent too much, but it is useless venting if the vent is at any point trapped and does not lead out of the mould.

As an illustration of the importance of venting, there is illustrated a set of water-jacket cores of the Rolls-Royce cylinder-block. In addition to wired vents, they use 1¼ lbs. of wax taper per set.

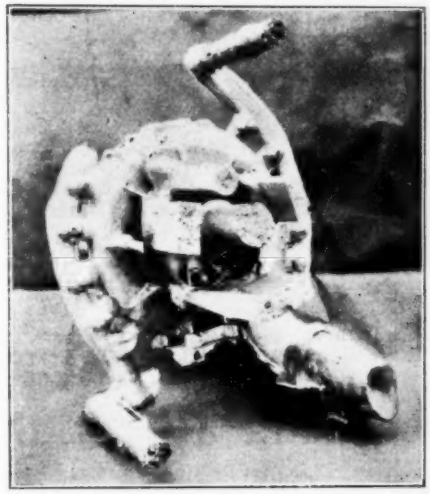


FIG. 17.—THIS SUPERCHARGER CASTING IS MADE WITHOUT THE USE OF CHILLS.

In the case of "Y" alloy and the 4 to 5 per cent. Cu alloy, runners and risers follow much the usual practice, care, however, being taken to create as little disturbance as possible, the smaller the runner the better. Chills must be adopted at the thick sections to even the solidification of the whole. With the American alloy, owing to the larger amount of contraction, cores must be made very collapsible, and liberal use of cinders or crushed coke in the interior of cores is a good thing. Serious thought must be given to the gating. Often if difficulty is experienced in running a casting the remedy is found in altering the gates. Sometimes it is found that the auxiliary runners may restrict contraction, causing the casting to crack during cooling.

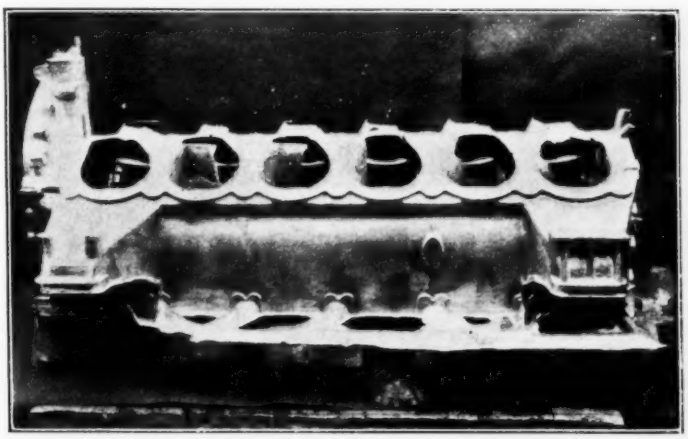


FIG. 18.—A CRANKCASE CASTING ALSO MADE WITHOUT CHILLS.

It is desirable owing to the hot-shortness of the American alloy and "Y" alloy to break the mould and remove the casting as soon as possible, and to "knock out" the cores to prevent cracking during contraction. This point is not so important with R.R. 50; quite delicate castings may remain undisturbed in the mould until cold if necessary, a distinct advantage since there is

not the fear of distortion due to breaking the mould too soon.

With R.R. 50 the runners and risers do not follow the usual practice, and the application of these important factors will best be illustrated by photographs of actual castings made at the foundry of Rolls-Royce, Limited. One feature

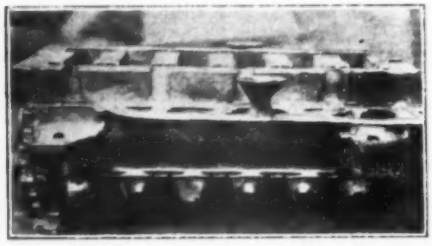


Fig. 19.—The Casting Shown in Fig. 18 Turned Over to show the Runners and Risers.

is the general thickness of the casting: the cylinder block and crankcase generally being 0.175 in. thick, whilst the supercharger is the same thickness with webs only 0.125 in. thick; the valve-cover casting, although being the same length as the cylinder block, is only 0.120 in., this and a

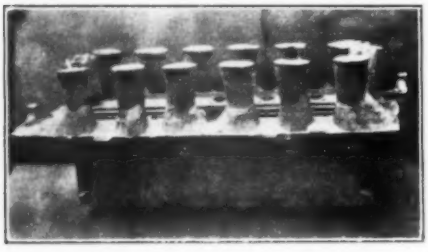


Fig. 20.—Cylinder Block and Head showing Method of Feeding.

recent batch for some important racing engines having been made down to 0.10 in.

Some Typical Results.

Fig. 15 shows a front view of a supercharger casting, tested by air under water at 120 lbs. per sq. in.; note that only the two chills are used on the bottom face, and also the two runners. Fig. 16 shows the top face with four small plate chills only. Fig. 17 is of another supercharger casing produced without the application of any chills.

Fig. 18 is the crankcase casting, bottom side up, no chills at all being used in the production. The two runners and the risers of this are better shown in Fig. 19.

Fig. 20 shows the combined cylinder block and head, which is tested in the water jackets to 80 lbs. per sq. in. air pressure, and 360 lbs. per sq. in. in the head. Note the feeder the whole length of the double runners at each side of the casting. Fig. 21 shows this cylinder block sectioned, giving the position of the only chills used.

Mould and Core Dressing.

For the mould, a dusted french chalk may be used, and french chalk and water for the cores, but a very much better dressing for both mould and cores, if one has the time, is to spray, after wet dressing with french chalk and water, with a mixture of boiled linseed oil, liquid ammonia and water in equal parts. This dressing is excellent for chills, whether of cast iron, gunmetal or aluminium. In permanent-mould die casting, "Y" alloy follows the usual practice, but better results are obtainable by using in the ladling-out furnace a graphite crucible well glazed on the outside. If an iron pot be used, then it should be taken out every day and thoroughly cleaned of all dross and old dressing, and whilst at about 200 deg. C. should be coated by one of the following dressings:—(*a*) 10 lbs. of whiting and 6 ozs. of water-glass in 5 galls. of water; or (*b*) equal proportion of cement and common salt mixed into a paste with hot water. The former is preferable, but the latter is used extensively by one of the large foundries in Germany. With R.R. 50 and R.R. 53, larger runners and risers are necessary, about 25 to 30 per cent. greater than for the ordinary casting alloys. It will be found that these two latter materials are much more free from the tendency to crack and draw.

The first dressing given for the iron pots is quite good for the mould of gravity dies, but used slightly thinner, or an equal proportion of graphite, beeswax and linseed oil; for the cores a wash of graphite in water is good, the cores being dipped into the mixture occasionally, or when necessary to coat them.

In conclusion, the author expresses his indebtedness to the technical staff of Rolls Royce, Limited, for the assistance given; to Mr. Wormald for the permission to reproduce many of the photographs, and some of the sectioned castings; and also to Mr. Robinson and his own laboratory staff at High Duty Alloys, Limited, for their work in preparing the specimens and conducting the tests.

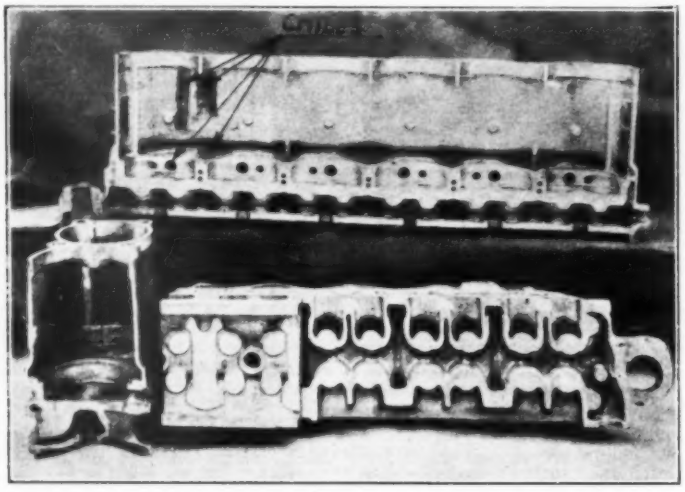


Fig. 21.—Here the Casting shown in Fig. 20 has been Sectioned and Gives the Position of Chills.

DISCUSSION.

Mr. N. McManus, M.B.E., the Branch-President, in introducing Mr. Devereux, said they would all welcome the lecturer and appreciate his kindness in being with them, as he had only returned from Poland the previous night. They felt very grateful to him for having hurried back in order to keep his engagement. Mr. Devereux was connected with a firm which had made for itself a name for the production of high-duty aluminium alloys, and he thought that what they would hear would be in the nature of a revelation to many of them.

Thermo-Couple Sheathing.

The Chairman, opening the discussion, said that they had listened to a most interesting Paper, and many things would be quite new to some of them. A great many figures of tests, compositions and treatments that were difficult to memorise had been given, which was somewhat unfortunate, for he was sure that they could have discussed the Paper better if the figures had been available previously. Nevertheless, there was plenty of matter for discussion. Mr. Devereux had a number of very interesting castings displayed in the room, and he thought many who had examined these castings would feel thankful that they had not to make them in cast iron. In connection with the taking of the temperature of the metal, it had been explained that duplicate thermo-couples were installed, and he would like to know whether the thermo-couples were sheathed or used bare, and, if the former, the nature of the protection used. He would like to mention for the benefit of any who had not examined the castings that he had been informed by Mr. Devereux that the long core was made in sea sand. The meeting was honoured with the company of Mr. Sutton, the Chief Scientific Officer at Farnborough, and Mr. McManus thought that they would be pleased to hear any comments that Mr. Sutton might like to make about the castings.

Melting Units for High-Duty Alloys.

Mr. Sutton expressed gratitude for the opportunity of remarking upon the Paper, to which he had listened with great interest. There was much that one could not assimilate by simply listening, and he looked forward to the time when he could peruse an authoritative copy of it. He had had many long arguments with Mr. Devereux on the matter of high-duty alloys, and he knew the difficulties to be met with in casting high-class material such as had been dealt with. There were one or two points in the Paper which had impressed him very much. Mr. Devereux had not suggested one alloy to be used as a panacea for all their troubles, and he thought that the author was right in that attitude. There were some people who stated that, if only such and such an alloy were used, all troubles would be eliminated. There was no one alloy suitable for all jobs. Mr. Devereux had not stressed all the difficulties met with in the casting of alloys, such as "Y" alloy. "Y" alloy was good for some jobs, and particularly for forging, but sand castings were very liable to be full of pinholes. Mr. Devereux had graduated in the old hard school of the foundry floor; he himself was still on it. He was wondering which factor above all others permitted the securing of sound castings in these high-duty alloys, such as "Y" alloy. Was it the melting? If so, what was the best method of melting? He thought that a great many castings were spoilt through the use of a gas furnace: coke was a little better and oil still better, but for real luxury casting the electric furnace might be used. He was interested in the heat-treatment method. Mr. Devereux had advised the use of a frozen and crushed salt bath, and he would like to question whether it was a really practical job. The British successes in high-speed transport were a great compliment to British high-duty light-alloy castings.

He personally felt very proud to-day of the British light-alloy casting industry.

Fatigue Test Results.

MR. J. ARNOTT said that to anyone who was interested in such alloys, he would recommend the study of the reprint of a Paper by Mr. Devereux before the Automobile Engineers. The whole story told in the present Paper was a justification of the application of laboratory methods on a commercial scale. It was delightful to be able to see what could be done when cost was not the sole or main consideration. As a rule, the cost of the casting, he thought, was put too much in the forefront. The Paper contained so much data, some of which was entirely new to him, that he had not yet been able to digest it. He wished to refer to the fatigue tests, where he noted the results spread over a range of something like 4.4 tons. Had Mr. Devereux any comparative figures for the silicon alloy? Regarding the friction test described by the author, wherein the specimens were run against a carbon steel, he wondered why steel was used, and asked if Mr. Devereux could give any figures for specimens run against cast iron under such conditions as obtained in ordinary automobile practice.

Chills and Porosity.

He noted that the author had a great antipathy to chills. What were the objections to the use of chills in sand moulds? In the case of ordinary automobile castings, the use of chills made possible the production of castings otherwise impossible, at least that was so in the case of the silicon alloy. Was the objection due to the cost, or to the trouble of making the chills or other reasons? He confessed that he did not follow Mr. Devereux's objections to the use of chills. An outstanding feature was the high Brinell figure obtained. He hoped that the good work of Mr. Devereux and his firm would permeate to the automobile industry where, at present, any rubbish seemed to be put into pistons. The case of co-operation between the designer and the foundry had been emphasised, but the buyer had been omitted, and the buyer was the person who should be included. When one found finished machined pistons being purchased for 5s. 6d., it was quite obvious that the buyer had been the only person concerned, and that all heat-treatment, etc., had been eliminated. It was quite interesting to note that porosity had not been the predominating feature of this Paper; in most Papers dealing with aluminium alloys, porosity and its prevention were very prominent features. He assumed that porosity was not a serious problem in the case of the castings dealt with. Had the temperature control any influence upon it, or was it due to the high-class methods used? The Paper was full of valuable information which might be summed up as the methods of the laboratory applied on a manufacturing scale, and undoubtedly that was the reason why the author's organisation had, in so comparatively short a time, become the second largest purchaser of virgin aluminium ingot for casting purposes in this country.

Sand-Blasting Reveals Unsuspected Defects.

MR. J. MILLER said he was much in agreement with Mr. Devereux's remarks about co-operation between the designer and founder. The founder nearly always wanted a little more than he had got, but he thought it could be taken as a fact that if the founder asked for more, it was a necessity for the production of a good casting. Referring to the control of the casting temperature, what type of couples was used? He noted the duplication of the couples, but who decided when and at what temperature the metal should be cast? If the metal reached such a temperature that it could not be cast to give satisfactory results, was it scrapped? Were chaplets used in those castings which seemed so thin, and were the cores held up by extension of the print? He asked if the castings exhibited were sand-blasted. Anyone who had had experience of cast iron knew that what appeared a perfect casting before, looked very different after sand-blasting. He agreed with Mr. Arnott that it was remarkable that no mention had been made of porosity. In cast iron porosity often gave trouble and in the case of steel they certainly had more of it than they wanted. In the case of these high-duty alloys, he noted the large quantity of wax vent used, and he presumed that by this method they had overcome what might have been a great nuisance.

MR. W. MCCULLOCH asked if Mr. Devereux thought it essential to have such heavy risers as illustrated.

AUTHOR'S REPLY.

MR. DEVEREUX thanked them for the reception they had given him and for the discussion of the Paper. In reply to the President, the thermo-couple used was a fairly long couple of iron-constantan, roughly 3 ft. long and covered with a steel tube to within about three inches of the end. The three inches at the end were wrapped in asbestos tape, and the actual couple was bare but dressed with a film of the dressing given for the iron pots. They lasted ten or twelve months with careful handling. The silicon alloys are all easily cast but had their drawbacks, particularly in respect to porosity. The tendency, if iron was more than 0.3 per cent., was to increase the solidification range, and during solidification crystals formed in a matrix of eutectic and gaps were left.

Mr. Sutton and himself had worked very closely together, and he had had a great deal of help from Farnborough, just as he had from the N.P.L. and other places. The National Physical Laboratory introduced the "Y" alloy, which unfortunately was so neglected by designers and the foundry in this country. It was not so in America and on the Continent, where far more "Y" alloy was used than in this country. The British people neglected it, and he was happy in the fact that his own company did so much work on it and made it more favourably received. There were fields of usefulness for both "Y" alloy and R.R. alloys. The "Y" alloy was very difficult to use as a sand-casting alloy, and it was essential to use chills and be very particular about the solution treatment. The most important point was the ingot that was used. Actually 0.7 per cent. iron was too much, and the alloy he made contained 0.3 per cent. each of iron and silicon. The casting temperature was definitely important.

Life of Graphite Crucibles.

Mr. Sutton had raised the question of the type of furnace and fuel which should be used for melting these high-duty alloys. Coke was a very good fuel, but it was necessary to exercise exceptional care in drying it. It was also essential that a well-glazed graphite crucible be used. They obtained 60 to 80 heats from a pot when casting into ingots, and from 50 to 70 heats when heating up for sand castings. The glazing of the crucible was of the utmost importance, and his practice was definitely to discard the pot if the glaze showed the least sign of breaking. The coke seemed to cause damage to the glaze, especially if the coke was damp when charged. At the works with which he was connected, oil-fired furnaces were used with excellent results. They employed an oil of 0.95 specific gravity. He agreed with Mr. Sutton that gas-fired furnaces were liable to cause the metal to be full of gas, thus inducing pinholes and porosity. The electric furnace had not so far been developed to the stage where it could be recommended for the melting of large quantity production.

Mr. Sutton had referred to the frozen-salt bath method. It was certainly a difficult process, but a perfectly safe method of working. After a melt was done it was a nasty job to empty the salt out. The electric furnace generally was cheaper. He preferred the frozen-salt method because it was safe.

With regard to the fatigue tests, they were given only up to 40 millions; he did continue up to 100 million reversals and he had found no further drop, and this had been confirmed by McAdam in America. McAdam also said that there was no evidence of drop beyond 200 million reversals. The R.R. alloys were much more used than any other alloy for pistons against iron as well as steel, but he had not attempted to get the actual friction curve for those alloys against cast iron.

Objections to Chills.

Mr. Arnott had asked why he had such an objection to the use of chills; there were several reasons. For one thing it was difficult to know in a sand-casting foundry when a chill was left out. One did not get consistent results, structure, properties, etc., between the chilled and unchilled portions. Chills could not be excluded entirely when it was impossible to feed properly. Where the runner and risers were not proportioned correctly, the eutectic in forming left spaces not filled, and as a last resort chills had to be used. Chills were practically essential in castings of "Y" alloy. In the case of "Y" alloy one of the troubles was that with heavy feeders they had speckiness.

Mr. Miller had asked if he had trouble from pinholes or porosity. Fortunately in the R.R.50 alloy he had not; if the alloy were cast at the correct temperature, the castings were sound. If the temperature were higher they had speckiness. The titanium, which acted as a refiner of the grain, also acted as a cleanser of the metal. He referred them to Prof. Hanson's Paper on the cleansing of molten metals.* The Brinell figures shown were not the maximum, as they could reach 160 by heat-treatment. In the case of sand castings, they could easily get a Brinell hardness of 120. If a particularly hard material were required, it was obtained by chilling. Mr. Arnott had said that he had left out of consideration the buyer, but that was not the case, because he had mentioned the cutting of prices, especially in England, and had said that he simply did not know how the foundry made profit on the job at the price. It was necessary to quote a fair price if any profit was to be had out of special work. There was only one possible way of making it pay at low prices, and that was to use a large amount of scrap and secondary material. They could not get castings to withstand high and severe stresses except by the use of the best materials and modern methods.

Pouring Practice.

The freezing range of the R.R. alloys was short, and in order to get sound castings they had to arrange for the solidification to take place in that range; for that reason heavy risers had to be used. In regard to the casting temperature, who decided when and at what temperature the metal should be cast, and what happened when the right temperature was exceeded, it was the job of one man to decide when casting should take place. They had the temperature control posts distributed throughout the foundry, probably 20 yds. from where the man was working. He controlled the temperature absolutely, and worked so close that the metal was rejected at a margin of 3 deg. In the case of R.R. alloys, there was little fear of exceeding the temperature given, which was 820 deg. C. If that were exceeded, the whole of the material was taken up to 900 deg. C. and held for a time, say 15 min., and allowed to cool to near the pouring temperature slowly. If it were not convenient to do this at the time, the melt was ingotted and remelted with new metal. In the case of "Y" alloy, the metal was ingotted and remelted with 25 per cent. in new metal. Chaplets should not be used in castings of these alloys. Holes in the cylinder were

(Concluded on page 352.)

* FOUNDRY TRADE JOURNAL, September 24, October 1 and 8, 1931.

Moulding a Water-Seal Gas-Valve Pan.

By Robt. Jones.

Fig. 1 shows in plan and elevation a cast-iron pan, made with the minimum of patternmaking and struck up in the foundry floor. The method adopted and here described was decided upon as

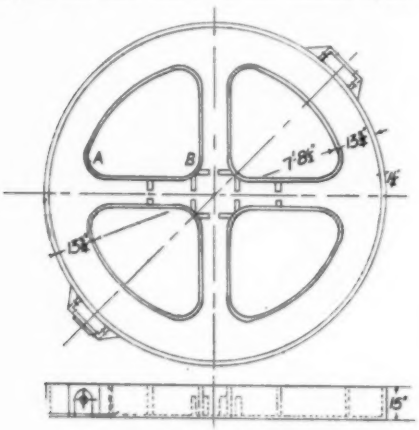


Fig. 1.

an expedient in an emergency case. The first item in the sequence of operations was to dig out a circular hole in the foundry floor, approximately 10 ft. in diameter and 20 in. deep, on

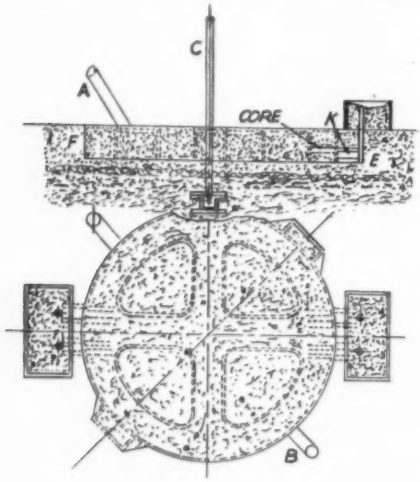


Fig. 2.

the bottom surface of which was laid a coke bed, as shown in Fig. 2. This diagram also shows the fixing in position and the vent pipes at A

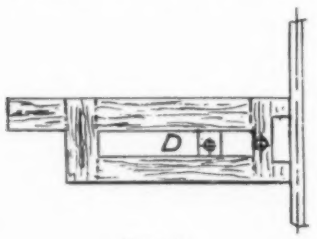


Fig. 3.

and B. Spindle C was next fixed in its socket, the latter being secured to a circular box-part taken from stock. Strike-board D, Fig. 3, was then secured to the spindle in the usual way, and with the aid of this board a true surface bed was formed at E, Fig. 2. A true circular bed or ring, shown at F (Fig. 2), was rammed with sand, which formed a true guide to locate segment G, Fig. 4, which formed the outside and inside walls of the outer ring.

The cross pattern shown in Fig. 5 was fixed in position on the sand bed E (Fig. 2) already

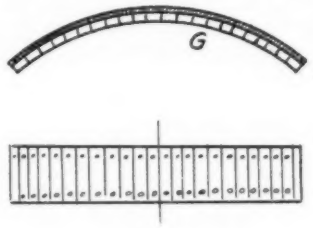


Fig. 4.

referred to, and sand was rammed inside and outside of the flanges H, Fig. 5. Segment J (Fig. 5) was located in position on each quarter

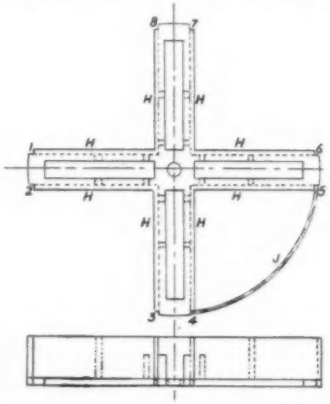


Fig. 5.

of the circumference of the inner ring at points 1 to 8. Both outside and inside segments were in their respective positions while this was in progress.

Fig. 6.

Fig. 7.

Strike K, Fig. 6, was used to form the thickness for the metal between the inner flanges. Runner cores L, Fig. 7—four in number—were fixed in pairs at opposite ends on the surface

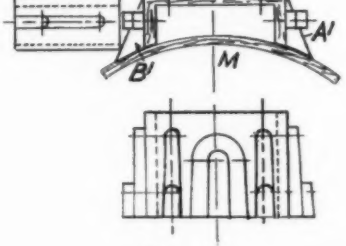


Fig. 8.

bed and well secured in position in the direct line of the flow of metal into the flanges H.

A circular fireclay nozzle brick was fixed at the end of these runner cores, and connected to the vertical gate as shown at K, Fig. 2. The anchorage bracket-pattern shown in Fig. 8 was simple in construction, and did not present much difficulty. The short segment M, Fig. 8, was fixed in the mould to prevent any damage being done to the inner cores whilst the process of ramming this bracket was in operation. Strengthening brackets A^1 and B^1, Fig. 8, were covered with a slab core, as is usual in this practice.

Fig. 4 shows in detail the method employed to construct the two segments referred to;

Fig. 9.

wrought-iron plates ¼ in. thick were first bent to their respective diameters and drilled to take wood screws, which secure the timber segments. Fig. 9 shows the segments—two in number—corresponding to the respective radii at A and B, Fig. 1. These were used to form the rounded corners after the pattern was withdrawn from the mould. The casting produced by the method described in cast and quality gave satisfaction to all concerned.

High-Strength Sand-Casting Aluminium Alloys.

(*Concluded from page* 351.)

utilised for the support of the cylinder cores, and a specially long print was provided for. As to sand-blasting, only one of the specimens had been so treated. He admitted that sand-blasting would reveal defects, if they were present, which could not be seen before the treatment.

The fatigue value of the aluminium-silicon alloys, modified by the addition of sodium, was given by some authorities as $\pm 3\frac{1}{2}$ tons per sq. in. at 10 million reversals, but, of course, owing to the practical absence of any limit of proportionality, the material if stressed to the figure given would fail first by plastic deformation.

Vote of Thanks.

Mr. McManus, on behalf of the members of the Branch, thanked Mr. Devereux for his most interesting Paper, which had dealt with some materials giving, in many directions, unique results. It had given them an insight into the handling and behaviour of high-duty alloys with which they were not very familiar. The Paper had proved extremely interesting, and he asked them to accord a vote of thanks to the author for the trouble he had taken in preparing the Paper and illustrations.

Mr. Devereux, in the course of his reply, said it was interesting to note that the machines which might have been entered by Italy and France for the Schneider race had parts of the engines made of these alloys, so that had Britain been beaten in the race they would still have had much to do with the result. In thanking them he hoped that, as they elaborated the study and manufacture of high-duty alloys, he might be able to give to them another Paper.

Tantalum-Carbide Cutting Tools.—Research engineers connected with one of the large manufacturing firms of electrical equipment in the United States have succeeded in producing a carbide of tantalum considerably tougher than the tungsten carbide. This tantalum carbide made into cutting tools recently performed satisfactorily when tested on steel at a speed 40 per cent. in excess of the limit for a high-speed tool, the same cut being taken in both instances. Apparently the tantalum carbide tool could have functioned at even a much higher speed had the capacity of the machine permitted.—"The Iron Age.

XUM

Alloy Cast Irons.*

By Gerald S. Bell, B.A. (Oxon.)

The title of this Paper has been chosen rather loosely, for, of course, every form of cast iron is in itself an alloy, and, moreover, a very complicated alloy, too. Actually, reference is to be made to the effects of adding to an ordinary grey cast-iron mixture, various proportions of metallic elements. It is suggested that a point has been reached where there is a potential danger to what is a hopeful metallurgical development of considerable practical assistance to the foundryman and to the engineer. This lies in the tendency to claim too much and to expect too much from these alloy additions to cast iron. If this tendency develops too far, then the optimists are liable to experience a reaction and to witness a setback to progress.

The engineer, in his constant search for higher-class materials, is often ready to be over-optimistic when the potential advantages of some new material are put before him. His optimism and his enthusiasm in themselves can often be a temptation in leading the metallurgist to take too rosy a view.

One thing which should always be borne in mind is the cost of material. It is easy to reach a point when the cost of the alloy addition is not compensated for sufficiently by the better qualities of the material so obtained. At that moment, one has no longer got a commercial proposition. Though obvious this is sometimes forgotten.

Nickel in Grey Cast Iron.

Briefly, the irons produced by the addition of increasing percentages of nickel to grey cast iron can be simply classified under three headings:—

(1) *Nickel, 1 per cent. to 2 per cent.*—In this class the iron is grey throughout, and can be machined without difficulty. The combined carbon is in a fine pearlitic condition, and the graphite is split up in the dendritic form—*i.e.*, as evenly distributed thin flakes. From many points of view this is the most useful and important class of nickel cast iron. As the nickel content is increased, it is found that, generally speaking, the pearlitic structure of the combined carbon becomes sorbitic, until another class of iron is obtained, viz.:—

(2) *Nickel, 5 per cent. to 7 per cent.*—In this, the sorbitic structure has become definitely martensitic. Although the castings have a definitely grey structure, they are very hard and difficult to machine. Their applications are special and somewhat limited to conditions, such as abrasive wear. As the nickel content is increased above 7 per cent. the martensite gradually gives way to austenite, and, finally, gives the third class of casting, viz.:—

(3) *Nickel over 20 per cent.*—With the nickel content over 20 per cent. the iron is completely austenitic, with a series of properties quite different from those of ordinary cast iron.

1 to 2 per cent. Nickel Iron.

It is useless making any alloy addition whatever to grey cast iron unless the basis mixture to which the alloy is added is of the correct analysis in relation to the casting which is going to be poured.

In adding nickel to grey cast iron, there are two constituents which have got to be controlled—the total carbon and silicon. The remainder of the constituents in the iron, the phosphorus, sulphur and manganese can be adjusted as one would normally regulate them according to the class of casting envisaged. The nickel exerts its main influence in its effect on the combined carbon, and this influence is not affected by variations in the other constituents of the iron, with the exception of silicon.

To obtain maximum strength, it is advisable to keep the total carbon content low, especially the graphite, but, at the same time, to ensure that the combined carbon is not too high to make machining difficult. The effect of nickel on a white iron is, though not to such a great extent, the same as silicon, viz., to turn it grey. This has to be borne in mind when the silicon content is regulated. Thus, for any casting of given cross-section for which, say, 1½ per cent. of nickel is to be added to the mixture, the silicon content would be made correspondingly lower than if the casting were to be poured out of ordinary cast iron.

Lastly, it has been found that when nickel cast irons are to be produced from the cupola, it is highly advisable to run the basis mixture into pigs first, remelt these and add the nickel to the remelt. It is not suggested that this is necessary in every case, but the author has found it to be essential to the successful production of castings in which the highest degree of strength and grain closeness is of primary importance.

The remelting process necessarily entails the calculation of melting losses, but this does not present any difficulty, and a basis refined pig is obtained, the analysis of which is known within very close limits. This remelting of the basis iron is particularly advantageous when it is necessary to include any considerable proportion of nickel cast-iron scrap in the cupola charges.

Addition of the Nickel.

When nickel was added to cast iron in the earlier stages of development, it was added in the form of pure nickel shot, but it was found as the result of practical experiments that this method did not ensure complete admixture or solution. In consequence of this, nickel is added in the form of a nickel-silicon alloy containing about 90 per cent. of nickel, and whose melting point approximates to the normal temperature of molten cast iron.

It has always been found to be most effective and convenient to add this alloy (generally known as F-nickel) in the form of shot. Furthermore, the best results have always been obtained by tipping the shot into the stream of molten metal in the cupola spout as it leaves the tapping hole. If required, nickel-silicon ingots can be obtained for melting in the cupola with the charges. But whatever the total weight of the melt may have been, personal experience has not been that the latter method is so efficacious as the first.

By adding the nickel at the cupola spout in the form of shot, there is greater security and economy in arriving at the desired percentage of nickel content. One knows almost exactly what weight of metal each ladle holds, and by this method of addition the calculated nickel content can in all cases be obtained with great accuracy.

It is generally claimed that the percentage loss of nickel due to oxidation, etc., can be reckoned as non-existent to all intents and purposes. Using the method of alloying described, this claim is completely substantiated, provided that elementary precautions are taken. For instance, it is always advisable to have at least 6 in. of molten metal in the bottom of the ladle before the nickel addition is made in the cupola spout. After the first addition, subsequent ones can be carried out at regular intervals, but the total addition should be complete by the time that the ladle is two-thirds full. It should also be noted that by adding the shot to the stream of molten metal it gets automatically drawn down below the surface of the metal in the ladle, and does not tend to get caught by any slag layers which may be present. Finally, it is essential to have a clean metal and to have it as hot as possible.

Pouring Castings in Nickel Cast Iron.

Generally speaking, no essential modification need be made to the methods which one would use for any particular casting with ordinary cast iron, as, for instance, the arrangement of runners, gates, risers, feeding heads, etc. The use of nickel cast iron sometimes eliminates, but quite often does not obviate the necessity of hand-feeding in cases where it has been essential with ordinary cast iron. The influence of nickel goes a long way towards closening grain structure and promoting an even distribution of this closeness as between thick and thin sections in juxtaposition. But from experience it does not go so far as to do away with the necessity for hand-feeding certain castings.

Potential Applications of Pearlitic Nickel Cast Iron.

Briefly, the use of this material can best be justified in instances where the following properties are of primary importance: (1) Closeness of grain structure throughout every section of a casting; (2) resistance to wear, and (3) high strength. These three properties are, of course, largely inter-related, but in order to be as clear as possible it is proposed to treat them in separate categories.

Even Closeness of Grain Structure.—If one has to make, for instance, in ordinary cast iron, a heavy solid cylindrical block of large diameter, and it is necessary that the material at the centre of the casting be as close in grain as possible, one naturally lowers the silicon content of the iron. The desired effect might be obtained by this method, but a section taken through the casting would reveal that the structure of the iron varied considerably from the surface of the cylinder to its centre. According to the thickness of the section, and hence the silicon content, a structure varying from mottled or white at the outside to (possibly) a medium close-grey at the centre is shown. Taking it, however, as a general rule that 2 to 3 parts of nickel effectively replace one part of silicon, and having carried out this replacement, it would be found that for all practical purposes the cylindrical block would have the same close structure throughout the whole of its cross section. Experiments have been made with blocks of this type of 6½ in. diameter and over, when it has been found that there is practically no vibration in structure throughout the section, and no appreciable variation in Brinell hardness number, when a series of impressions are taken across the diameter.

In other words, the effect of the nickel addition has been to prevent the formation of white iron on the surface, where the cooling is quick, but at the same time to closen the facture at the centre, where the cooling is slow. Exactly the same effect is found when nickel is added, and silicon correspondingly reduced, in a casting where a thick section is against a thin one. The fracture of the thin section is kept grey, and the thick section remains close, without any tendency to shrink.

Thus there is presented an apparent anomaly. It would seem as though the addition of the nickel is having two opposite results in the same casting; in effect, to turn white iron grey and grey iron white.

The following brief explanation may, however, serve to show that there is no real anomaly at all. At the same time it should be noted that it is only an explanation of what actually does happen, and not of why it happens.

If one adds continuously silicon to an iron, a curve can be plotted showing the relation between the amount of combined carbon in the iron and the amount of silicon added. This curve will fall sharply at first, but will then

* A Paper read before a joint meeting of the Manchester Metallurgical Society and the Lancashire Branch of the Institute of British Foundrymen, Mr. J. S. G. Primrose presiding.

flatten itself out into a step. The length of this step indicates the period for which the combined carbon is in the pearlitic condition. The same iron with nickel added to it in the place of silicon gives exactly the same type of initial fall in the combined carbon content, but also shows a curve flattened out into what may be called the "pearlitic step," the duration of which is much more prolonged than in the case of the silicon addition.

The effect of adding between 1 and 2 per cent. of nickel, and lowering the silicon accordingly, is to produce a pearlitic structure throughout the casting. The presence of the pearlitic condition persists over a much wider range of composition than it does in ordinary iron. Moreover, it is found that the pearlite exists in a finer state in the nickel iron than it does in the ordinary.

Marine Diesel engines are machined all over, the finished thickness of the flange part being 2½ in. and the stem 2⅜ in. There is a very awkward position in the casting where shrinkage and open structure are extremely likely to occur. The problem is not made any easier by the fact that a ⅝-in. reamered hole is put through the stem and the flange of the casting. The texture of the metal throughout the length of this bore has to be perfect and uniform. The slightest suggestion of porosity or unevenness in grain involves a rejected casting. Furthermore, the castings when finish-machined, are subjected to an oil-test pressure of between 14,000 and 16,000 lbs. per sq. in. The author's firm eventually succeeded in making these castings quite successfully with a pearlitic nickel cast iron, but this was a case in which hand feeding could not be dispensed with.

Another type of Diesel engine fuel pump for which nickel cast iron has found an application is for high-speed Diesel engines similar to those which are now being installed in increasing quantities in motor omnibuses and commercial vehicles. For the manufacture of these pump bodies lengths of nickel cast-iron bar are required, about 2½ in. diameter. The core of this bar has to be perfect, as it is drilled and broached to take the pump plunger. In the case of the big marine Diesel fuel pumps, if the bores appeared perfect when examined with lenses and mirrors and if the casting passed their very exacting pressure tests, all was well and they were approved. With these smaller pumps, however, a different method was adopted by the customers to test the soundness of the bar centres.

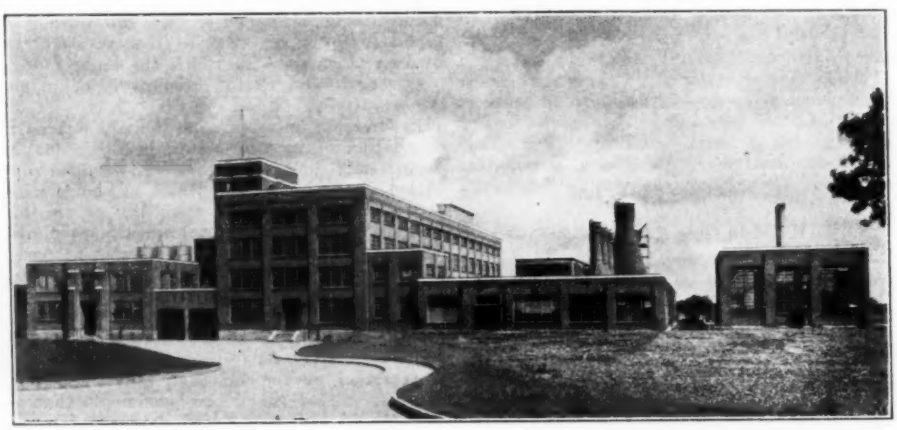
A certain number of the bars as cast (*i.e.*, 2½ in. diameter) were selected and were then turned down to the smallest B.E.S.A. test-piece whose diameter is 0.280 in. Tensile tests were then taken and if these proved in any case to be less than 18 tons per sq. in. the bars were all rejected. Other difficulties similarly overcome include gas cylinders which are subjected to a gas pressure of 3,000 lbs. per sq. in., and small bushes which have to withstand oil pressures of 3,000 lbs. and over without any distortion; moreover they are drilled and broached to present a perfect surface for the plungers in Diesel engine atomisers. On the outside of the bush a very delicate thread is cut to filter from the fuel oil any foreign body whose dimension happens to exceed 4/1000th of an inch.

(*To be concluded.*)

Details are now available of the allocation of shares in Textile Machinery Makers, Limited, the new combine which is to amalgamate six firms engaged in the manufacture of textile machinery. In all 1,835,000 preference and 1,615,000 ordinary shares will be allotted, as follows:—Platt Bros. & Company, Limited, 981,000 preference and 610,000 ordinary; Howard & Bullough, Limited, 327,000 preference and 550,000 ordinary; Dobson & Barlow, Limited, 227,000 preference and 225,000 ordinary; Asa Lees & Company, Limited, 180,000 preference and 65,000 ordinary; John Hetherington & Sons, Limited, 67,000 preference and 92,000 ordinary; Brooks & Doxey, Limited, 53,000 preference and 73,000 ordinary.

The Norton Grinding Wheel Company.

Last Thursday, representatives of the Press inspected the new Norton Grinding Wheel Factory at Welwyn Garden City. As an example of intelligent factory planning and operation, this concern is an outstanding example. The raw materials, mainly in the form of grits and powder, are taken up to the top floor by lift, fed into hoppers, terminating in pipes situated over a light railway on the floor below. On the rails run light trucks which carry the weighed materials to the mixing machines. Some of these closely resemble the paddle mixers used for oil-sand preparation, whilst others, where the material is in the form of a slurry, use two sets of propellers revolving in opposite directions. The drying of the wheels is strongly reminiscent of a core-drying department of a foundry, only a lower temperature is maintained. Certain of the wheels are rammed up with pneumatic rammers, whilst others are just strickled off. Other types are fashioned under quite heavy Davy hydraulic presses. Finally, the baking is carried out in circular coal-fired kilns of the type used in the potteries. The exterior of these furnaces is painted white, with the ironwork picked out in black, making the whole appear like a Tudor cottage. The whole of the walls and machinery is painted with aluminium. The inspection and testing departments are such as give the user every confidence in Norton products, as strength, hardness, balance and dimensional accuracy are all very carefully determined. As the foundry industry is perhaps the largest consumer of grinding wheels, we suggest that the more southerly Branches of the Institute of British Foundrymen would be wise in bearing the name of Norton in mind when considering their programmes of works visits.



The New Factory of the Norton Grinding Wheel Company, Limited.

B.I.A. Seeks Increased Membership.

A further meeting of the Joint Conference of Manufacturers and Merchants, who have for months past been discussing the possibility of a working arrangement between the producing and distributing sides of the light-castings industry, met again last week. The same afternoon a meeting was held with certain non-associated founders who had been invited to discuss with members of the conference the new situation arising out of the negotiations. Some 18 firms hitherto non-associated were represented at this meeting, and a united appeal was made to them on behalf of the merchant organisations and of the B.I.A. for their active co-operation in working the proposed agreement.

Emphasis was again laid by all who spoke on the preliminary necessity of a 100 per cent. membership of the more important manufacturers, and consequently those non-associated firms represented at the meeting were reminded that without their adherence there could be no satisfactory agreement at all.

Whilst it was clear that the outside founders present were impressed by the unanimity of view now prevailing among the associated manufacturers and merchants, and expressed themselves as entirely sympathetic with the efforts that are being made to improve trade conditions, it must be admitted that old doubts and suspicions have not yet been entirely removed, and that there is still a small number of founders whose support is considered essential unable or possibly unwilling to commit themselves even to the extent of attending the meeting. Consequently, although some progress was made in the form of a definite undertaking in writing by those who were present that they would forthwith join the B.I.A. as soon as the necessary strength was forthcoming, it is clear that the efforts that are being made will need to be continued, and that, strange as it may seem in these days of rationalisation and a more intelligent appreciation of the interdependence of those engaged in any industry, there are still founders unwilling to join with their fellows in order by united action to bring about that improvement in the industry which everyone admits is not only desirable but essential.

This being the case, it was considered by all present at the meeting referred to, to be of the highest importance for these efforts to be continued, as the alternative of unbridled competition and free, which means in practice uneconomic, prices, would undoubtedly be disastrous in the long run to the welfare of the industry as a whole.

Although, therefore, it was frankly admitted that the response may not have been at the moment as whole-hearted as the associated founders and merchants had wished, and, indeed, had a right to expect, there is nevertheless much to encourage the continuance of their efforts. It was agreed in particular that the close and friendly co-operation between the two sides of the industry must at all costs be maintained, and for this purpose the Conference decided to establish forthwith a standing Joint Consultative Committee of Manufacturers and Merchants, which would meet frequently in order to maintain the closest touch with one another and discuss any further steps which might be taken towards their common goal.

As a result of the discussion which took place it is clear that an overwhelming majority, both on the distributing and manufacturing sides of the light-castings industry, are at one in believing that a working agreement is in principle necessary and desirable. There is no difference of opinion whatever as to this. Furthermore,

(*Concluded on page* 356.)

This Week's News in Brief.

Trade Talk.

PRIESTMAN BROS., LIMITED, Holderness Foundry, Hull, have received an order for 18 excavators for Russia. Delivery has to be made in nine months.

EMPLOYEES OF Messrs. Sharp & Company, Limited, Lennox Foundry, Alexandria, have recently subscribed the sum of 13 guineas to charitable institutions.

MESSRS. SCOTT & SONS, Bowling, have launched a new steamer of 400 tons, Lloyd's 100 A1 class, which they have built to the order of The Newry & Kilkeel Steamship Company, Newry. Triple-expansion machinery is being installed by Aitchison, Blair, Limited, Clydebank.

THE TWIN-SCREW TURBINE LINER "Carthage," built for the P. and O. Steam Navigation Company, Limited, by Alexander Stephen & Sons, Limited, Linthouse, has run trials on the Clyde. A sister ship to the "Corfu," she has a gross tonnage of 14,000, and is designed for a speed of 19½ knots.

THE RUSSIAN ORGAMETAL DEPARTMENT (State Trust for Rationalisation of the Metal and Mechanical Engineering Industry) opened in Moscow last week a special foundry exhibition, which contains no machines, but only photographs, drawings, documents, catalogues and advertising literature.

MESSRS. LITHGOWS, LIMITED, Port Glasgow, have launched the twin-screw passenger steamer "King Aleksander I," built for Dubrovnik Parobrodska Plovidba, A.D., Dubrovnik, Jugoslavia, for coastal service on the Adriatic. The propelling machinery consists of twin-screw quadruple-expansion engines supplied and fitted by David Rowan & Company, Limited, Glasgow.

MESSRS. MIRRLEES WATSON COMPANY, LIMITED, Glasgow, have just completed a large sugar-milling plant for Natal Estates Factory, Mount Edgecombe, South Africa. The plant weighs some 650 tons, and is capable of milling 130 tons of hard canes per hr. and producing 15 tons of sugar per hr. The firm has in hand another plant for an Indian sugar factory. Messrs. Mirrlees Watson's foundry has been exceptionally busy for some months, and it has been necessary to run night shifts.

HEPWORTH & GRANDAGE, LIMITED, engineers and founders, of Bradford, to achieve urgent delivery of a Continental order, sought the assistance of an official of the Yorkshire Aeroplane Club, as a result of which a load of 1½ cwts. of products was conveyed from Bradford to Yeadon airport by motor-wagon, from Yeadon to Croydon by fast private aeroplane, and by Imperial Airways liner to Amsterdam. The goods left Bradford during morning business hours, and were delivered at Amsterdam the same afternoon.

THE CLOSE ASSOCIATION—almost complete identity—of the Lancashire Dynamo & Motor Company, Limited, and the Crypto Electrical Company, Limited, has for a long time operated with advantage to their clients. In the interest of increased efficiency and economy, complete amalgamation of the two companies will take place, as from January 1, 1932, under the joint title of Lancashire Dynamo & Crypto, Limited, Trafford Park, Manchester, and Willesden, London, N.W.10. No change will take place in the management except that closer relationship which will be beneficial to users of the firm's products.

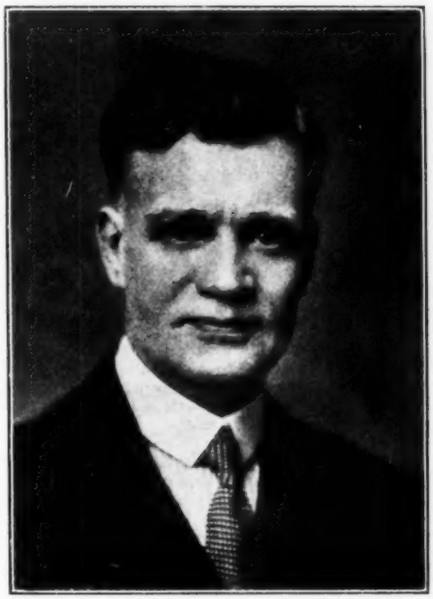
THE INTERNATIONAL TIN COMMITTEE, representing the Governments of Bolivia, the Netherland East Indies, the Federated Malay States, Siam, and Nigeria, at a meeting held at The Hague recently, announced their decision to make an additional cut in the production and export of tin of 15,000 tons a year from January 1. This reduces the output of the signatory countries in 1932 to 91,000 tons, or only 56 per cent. of the quantity they produced in 1929. A *communiqué* has been issued by the International Tin Pool stating that they have increased their holding to 15,800 tons from 12,250 tons at the end of October. This 15,800 tons of tin is included in the "available supplies" and is not for sale. United Kingdom stocks, at the end of October, amounted to 30,000 tons. The International Tin Pool have given guarantees to the signatory Governments not to sell any of their holding until the spot price of tin on the London Metal Exchange averages £150 a ton for one calendar month. Further, the Pool have undertaken not to sell more than 5 per cent. of their holding, even when this price is reached.

Personal.

MR IVAN CLARKE, formerly assistant foundry metallurgist to Hopkinsons, Limited, Huddersfield, has been appointed secretary of the Canadian Section of the British Chamber of Commerce in Paris.

SIR ARCHIBALD MCINNES SHAW, a former Lord Provost of Glasgow, and chairman of Messrs. Shaw & McInnes, Limited, Firhill Iron Works, Glasgow, was taken suddenly ill in the Conservative Club, Glasgow, recently, and the condition of his health has not yet permitted of his removal to a nursing home.

MR. T. F. DAVIES (manager of the company's South Wales eastern group of works), Mr. T. O. Lewis (manager of the company's South Wales western group of works), and Mr. F. S. Padbury have joined the board of Messrs. Richard Thomas & Company, Limited, to fill the vacancies caused by the resignations of Mr. Henry C. Bond and Mr. John Davies and by the death of Mr. Michael Falcon.



MR. A. G. LOGAN, PROVOST OF FALKIRK.

TO CELEBRATE the victory of Mr. Joseph Hepworth, M.P., in the recent general election, the 500 employees of Hepworth & Grandage, Limited, Bradford, on November 28 entertained Mr. Hepworth and his co-directors at a whist drive, supper and dance at the Connaught Rooms. The event had been organised entirely without the knowledge of the directors, and during the proceedings an electric reading lamp was presented to Mrs. Hepworth. Spokesmen on behalf of the employees paid tribute to the manner in which the firm had kept the works running.

PROVOST ARCHIBALD GRASSOM LOGAN, the new Provost of Falkirk, is a native of the town, born in 1867. He has been connected with the light-castings foundry trade all his life, having started work in a Falkirk foundry on leaving school. He was one of the prime movers in the formation in 1889 of the Central Ironmoulders' Association, of which he was President for a number of years. With the extension of the trade to the South, the scope of the Association was increased. Provost Logan is at present national organiser and treasurer of the British Ironmoulders' Association. He has been an active member of the Falkirk Town Council for the past nineteen years, and has done notable service as convener of the electricity department, which now supplies current at rates below those of any other similar municipal undertaking in Scotland. He was for some years a member of the Scotland National Joint Board for Electricity.

Contracts Open.

Dublin, December 7.—Iron and steel stores, for the Commissioners of Irish Lights. The Secretary, Irish Lights Office, Dublin.

Dundee, December 8.—Iron and steel stores, for the Dundee Harbour Trustees. Mr. J. H. Thompson, manager, Harbour Chambers, Dundee.

Fetcham, December 7.—Provision and laying of 1,080 yds. of 9-in. cast-iron main, for the Epsom Rural District Council. Messrs. J. Taylor & Sons, Caxton House, Westminster, S.W.1. (Fee £5, returnable.)

Johannesburg, January 8.—Centrifugal pump and electric motor, for the Rand Water Board. The Department of Overseas Trade. (Reference G.X. 10,941.)

Lancaster, December 7.—Iron and steel stores, for the Corporation. Mr. T. Hill, borough surveyor, Town Hall, Lancaster.

London, S.W., December 22.—Iron and steel stores, for the Lambeth Borough Council. Mr. O. Cattlin, borough engineer, Town Hall, Brixton Hill, S.W.2.

Storrington, Sussex, December 7.—Supply and laying of one mile 630 yds. of 4-in. cast-iron socket pipes, with fittings, for the Thakeham Rural District Council. Mr. H. B. Nichols, 13, Victoria Street, Westminster, S.W.1. (Fee £5, returnable.)

Reports and Dividends.

David Brown & Sons (Huddersfield), Limited.—Profit, £27,361; brought in, £117,287; dividend on the ordinary shares of 5 per cent.; carried forward, £118,000.

Birmingham Small Arms Company, Limited.—Loss for year, £112,944; debenture interest, £91,250; net loss, £204,194; brought in, £305,297; carried forward after payment of preference dividends, £77,219. No dividend is declared on the ordinary shares.

Tube Investments, Limited.—Net revenue, £239,422; brought in, £76,943; available, £316,365; preference dividends, £41,763; Government securities written down, £16,009; to reserve, £33,587; dividend of 8 per cent. on the ordinary shares, £150,009; carried forward, £74,997.

Obituary.

MR. RICHARD T. CRANE, JUN., president of the Crane Company, Chicago, died last month at the age of 58 years.

MR. J. J. KERMODE, managing director of Kermode's, Limited, oil-fuel engineers, Liverpool, has died at Birkenhead, aged 72.

New Companies.

International Alloys, Limited, 3-4, Clement's Inn, Strand, London, W.C.—Capital £1,000.

Thomas Carling & Company, Limited, Salop Street, Bolton.—Capital, £5,000. Brassfounders. Directors: Miss M. L. Carling, J. R., C. and E. Broughton.

KITSON & COMPANY, LIMITED, Airedale Foundry, Hunslet, are to supply eight locomotive boilers to the Iraq Railway.

MR. H. STEWART CRAIG, assistant general manager (commercial), is to have charge of the selling and buying organisation, which will be concentrated at the Millom Works, of the Millom & Askam Hematite Iron Company, Limited, the North Lonsdale Iron & Steel Company, Limited, and the Whitehaven Hematite Iron & Steel Company, Limited. An amalgamation between the first two companies has just been concluded. Mr. E. Le Tosh, as assistant general manager (works), will devote his full attention to the operative side at the various blast-furnace and foundry plants.

Raw Material Markets.

The more optimistic tone of recent weeks is still the dominant feature of the pig-iron markets. The actual amount of business done is limited by the fact that consumers have already covered their requirements to the end of the year. The steel market is quiet. Reports still emphasise the generally improved feeling on the iron and steel scrap markets.

Pig-Iron.

MIDDLESBROUGH.—Although the volume of business passing is still comparatively small, the undertone of the market is firm, and the attendance at the weekly meeting of the Cleveland iron market was well up to the average. The fact that consumers have largely covered their requirements to the end of the year and are consequently in no hurry to enter into forward commitments is responsible for the small volume of current business. Another factor is the belief that ironmasters would prefer increased output to higher prices and are of the opinion that stabilisation of values is in the best interest of consumer and producer alike. This confirms buyers in the belief that there is no urgency to buy forward. There is, however, no lack of confidence in the outlook. At the moment, deliveries under contract actually exceed the output, and the stocks which remain at the ironworks are being steadily drawn upon to meet producers' commitments. The fixed prices are as follow:—No. 3 Cleveland G.M.B., 58s. 6d.; No. 1 foundry, 61s.; No. 4 foundry, 57s. 6d.; No. 4 forge iron, 57s. per ton.

The East Coast hematite market is less active. The export market has fallen off, but the further fall in the external value of the £ will confer an additional advantage on exporters. To home consumers, particularly in Sheffield and the Midlands, substantial deliveries are going forward, and stocks are being heavily drawn upon. The price of East Coast mixed numbers keeps very steady at 65s. per ton. Buyers requiring special brands have paid 6d. to 1s. per ton more, but for ordinary commercial transactions 65s. may still be regarded as the basis figure. This, however, only relates to 1931 deliveries, and for next year's contracts premiums are asked.

LANCASHIRE.—Sellers in this area are not altogether dissatisfied with the position of the market, for, although there has been no further expansion in the demand from consumers, deliveries in the aggregate appear to be keeping up at the higher level of October. Quotations are all maintained, with Midland foundry makes on offer for delivery to users in the Manchester price zone at 67s. per ton, North-East Coast at 67s., Northamptonshire at 65s. 6d., Derbyshire forge iron at 62s., Scottish pig-iron at from 86s. 6d. to 87s. and West Coast hematite at about 81s.

MIDLANDS.—Further improvement is reported in this market. Some of the furnaces have been willing to book a little further ahead than they have been inclined to do in the last few weeks. Generally, the improvement in trade is still confined to the light trades, the heavy engineering industry having still very little work. For delivery to Birmingham and Black Country stations, producers continue to quote 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, North Staffordshire and Lincolnshire No. 3.

SCOTLAND.—Trade is not so good in Scotland. Sellers are complaining that the iron which was bought over the past few weeks is not being taken out as expected. Scottish No. 3 foundry iron remains at 69s. 6d. f.o.t. furnaces, and Cleveland No. 3 continues at 61s. 6d. at Grangemouth.

Coke.

The coke market shows very little change. Many consumers have covered their requirements, and current business is mainly confined to small lots. Deliveries are on a fair scale. Best Durham brands of foundry coke are worth 37s. 6d. to 39s. delivered Birmingham, with cheaper grades at about 35s. Welsh coke is sold in Birmingham at between 35s. and 47s. 6d., according to quality. There is little change as regards Yorkshire cokes, but prices are firm.

Steel.

Many more orders are wanted by the finished-steelworks. Only a limited amount of business is being done in heavy rails, sections, plates and joists. The market for small steel bars is more active, and prices are firm, owing largely to difficulties of trade with the Continent. The sheet trade is still quiet. Quotations for foreign semi-finished steel are only nominal. Practically no business has been done, buyers awaiting more settled conditions before placing fresh orders. British semi-finished steel is attracting a fair amount of orders, although few forward commitments have been made.

Scrap.

The tone of the iron and steel scrap market in the Cleveland area is more satisfactory. A steady buying movement has developed, and merchants will no longer sell at the low quotations which have recently ruled. The works are offering 42s. 6d. as a delivered price for heavy steel scrap, while machinery cast iron is at 47s. 6d. The recent improvement in the Midlands area is also well maintained. The market is steadier than it has been for some time past. Heavy steel scrap is firmly quoted at 37s. 6d., with light cast iron at 40s. No change in conditions is reported from South Wales. Only a moderate amount of business is being done. Heavy steel scrap in furnace sizes is at 47s. 6d. There has been a rather better demand for scrap experienced in Scotland. Prices are fully maintained.

Metals.

Copper.—The copper market, both in this country and the United States, has suffered a setback. Business is very slack, and the position is too confused to enable any opinion to be formed as to the future. Since the breakdown of the conference on curtailment, there have been rumours of withdrawals from the Copper Exporters Inc., but nothing definite can be said at present.

Closing quotations :—

Cash.—Thursday, £32 5s. to £32 7s. 6d.; Friday, £34 10s. to £34 12s. 6d.; Monday, £36 2s. 6d. to £36 5s.; Tuesday, £37 17s. 6d. to £38; Wednesday, £37 7s. 6d. to £37 10s.

Three Months.—Thursday, £32 17s. 6d. to £33; Friday, £35 to £35 2s. 6d.; Monday, £36 15s. to £36 17s. 6d.; Tuesday, £38 10s. to £38 12s. 6d.; Wednesday, £38 to £38 2s. 6d.

Tin.—The tin market has been firm. Business on the whole is rather disappointing, both in Europe and the United States, but the weaker dollar exchange and the recommendation by the International Tin Committee that curtailment to the extent of a further 15,000 tons should commence on January 1, have had a steadying effect on the market.

Official closing prices :—

Cash.—Thursday, £135 5s. to £135 7s. 6d.; Friday, £137 to £137 5s.; Monday, £136 5s. to £136 7s. 6d.; Tuesday, £138 7s. 6d. to £138 10s.; Wednesday, £137 5s. to £137 7s. 6d.

Three Months. — Thursday, £137 15s. to £137 17s. 6d.; Friday, £139 12s. 6d. to £139 15s.; Monday, £139 to £139 2s. 6d.; Tuesday, £141 to £141 5s.; Wednesday, £140 to £140 5s.

Spelter.—The spelter market is firm, and there is a confident undertone in the market, despite a rather disappointing consumptive demand. The price will soon respond to any change in the rate of consumption, for production is now down to a figure very little in excess of current needs.

Daily fluctuations :—

Ordinary.—Thursday, £13 13s. 9d.; Friday, £13 17s. 6d.; Monday, £14; Tuesday, £14 10s.; Wednesday, £14 7s. 6d.

Lead.—No change is recorded in this market. The demand is quiet, and consumers are well covered until next year. Supplies are sufficient for current requirements.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £14 11s. 3d.; Friday, £14 15s.; Monday, £15; Tuesday, £15 8s. 9d.; Wednesday, £15 1s. 3d.

Imported Steel.

RELATION TO PRODUCTION.

Sir William J. Larke, Director of the National Federation of Iron and Steel Manufacturers, comments in a letter to the Press on the answer given by the President of the Board of Trade in the House of Commons last week to a question by Mr. C. Peat, member for Darlington, as to the proportion which imported iron and steel bore to the total home production. Mr. Runciman said that during September last the proportion that the imports of pig-iron, ferro-alloys and steel ingots and castings into the United Kingdom bore to the quantity produced in this country was 2.93 per cent., compared with 3.51 per cent. during September, 1930. During October, 1931, the proportion was 4.61 per cent., compared with 3.81 per cent. during October, 1930. Sir William Larke points out that the reply was calculated to suggest that the imports of iron and steel were negligible in relation to production.

The extremely low figures obtained by the Board of Trade were apparently the result of relating the imports of ingots and castings, in which there is very little import trade, to the production of steel ingots and castings, and ignoring the greater imports of steel in semi-finished and finished forms subsequent to the ingot stage. In 1929 the output of steel ingots and castings amounted to 9,636,000 tons, a monthly rate of 803,000 tons. Since 1929 the production of steel has been steadily declining until in October this year, the latest month for which figures are available, the output of steel ingots and castings amounted to no more than 457,000 tons. In 1929 imports of steel in various forms amounted to 2,431,000 tons, equivalent to 3,000,000 tons of ingots, and imports of steel therefore represented 31 per cent. of home production. In October, when only 457,000 tons of steel were produced, imports of steel in various forms amounted to 233,900 tons, equivalent to 278,500 tons of ingots, so that in that month imports represented 61 per cent. of production, or nearly twice the rate obtaining in 1929.

B.I.A. Seeks Increased Membership.

(*Concluded from page* 354.)

there is a similar unanimity that an agreement such as has been drawn up and approved by the respective organisations would be of mutual benefit and advantage, and would do much to ensure fair play to all parties, producers, distributors and consumers alike.

Nothing remains, therefore, except the acquisition of the necessary strength to carry it into effect. Until this is achieved, progress must be delayed, as it would be unreasonable to expect the associated founders and merchants to permit an agreement arrived at after so much expenditure of time and thought, to be selfishly undermined by those who will not co-operate, and who may desire, as has been done before, to try and exploit the situation to their own individual advantage. However, the B.I.A., in close conjunction with the merchant organisations, intend to continue their efforts for the general good, as it is believed that reason and common sense must ultimately prevail.

Dirty lead baths can be cleaned by throwing in a handful of dry common salt, stirring and then removing the dirt which comes to the surface.

Lead can be prevented from adhering to steel by first dipping it in a saturated water solution of potassium cyanide, and then allowing it to dry before putting it in the bath.

Non-Ferrous Metals in Architecture.—Nearly 900 tons of copper, brass and bronze have been used in the new Department of Commerce building at Washington. According to data of the Copper and Brass Research Association (states the "Iron Age"), bronze finds application in entrance gates, doors and hardware and lighting fixtures. About 270 tons of brass pipe assure a rustproof water supply, and the roof is flashed with copper, downspouts being of the same metal.

Safety — Comfort WILLSON GOGGLES **Satisfaction.**

This is what WILLSON GOGGLES stand for.

Chippers style (L31½) fitted with WILLSON SUPER-TOUGH Glass.
Positively no eyestrain or headache when this goggle is worn.

THERE IS A WILLSON GOGGLE FOR EVERY INDUSTRIAL NEED.

Look for the WILLSON name on the frame.

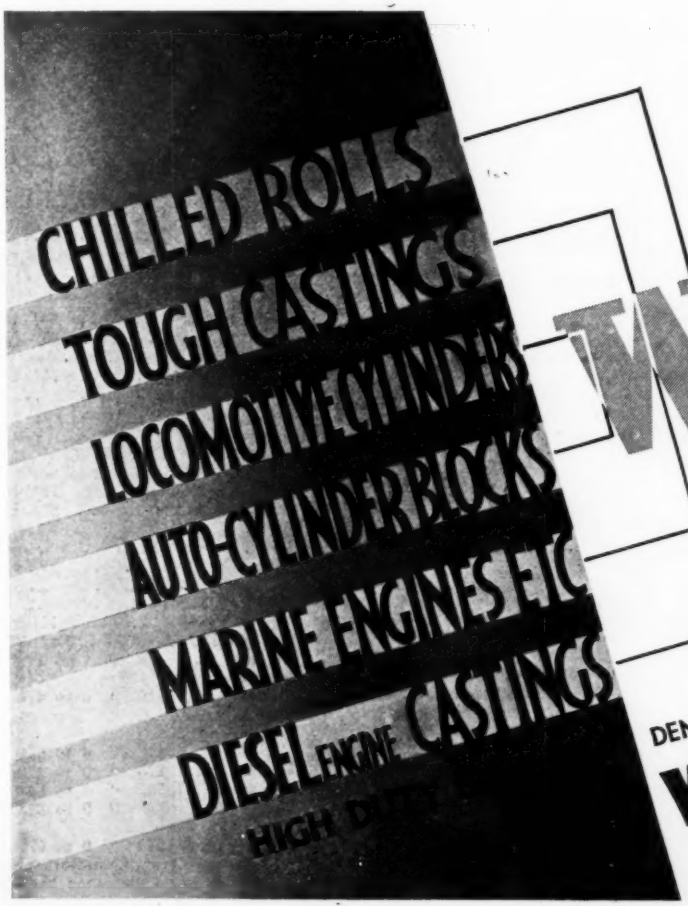
WRITE FOR CATALOGUE:—

Sole Distributors for Great Britain—
S. PULZER & SON, LIMITED.
45, HATTON GARDEN, LONDON, E.C.1.

CAST IRON FLANGED PIPES
2 in.—12 in. & CONNECTIONS. to 24 in. dia.

WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.

JAMES & RONALD RITCHIE, LTD.,
Telephone: 3852 (2 Lines). **MIDDLESBROUGH.** Telegrams: "Ritchie, Middlesbrough."



WARNER C·B·R

DEMAND HIGH GRADE PIG IRON
WARNER & CO., LIMITED.
CARGO FLEET · MIDDLESBROUGH.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	37	7	6
Three months	38	0	0
Electrolytic	43	0	0
Tough	39	0	0
Best selected	39	5	0
Sheets	70	0	0
India	53	0	0
Wire bars	47	0	0
Do., January	47	0	0
Do., February	47	0	0
Ingot bars	47	0	0
H.C. wire rods	49	0	0
Off. av. cash, Nov.	35	18	1½
Do., 3 mths., Nov.	36	9	10 3/16
Do., Sttlmnt., Nov.	35	17	11½
Do., Electro, Nov.	42	1	2⅝
Do., B.S., Nov.	38	3	1½
Do., wire bars, Nov.	42	18	6⅝
Solid drawn tubes			10½d.
Brazed tubes			10½d.
Wire			7¼d.

BRASS.

Solid drawn tubes	9½d.
Brazed tubes	11½d.
Rods, drawn	8½d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	7½d.
Wire	8d.
Rolled metal	7⅝d.
Yellow metal rods	5d.
Do. 4 × 4 Squares	6d.
Do. 4 × 3 Sheets	6d.

TIN.

	£	s.	d.
Standard cash	137	5	0
Three months	140	0	0
English	138	15	0
Bars	141	0	0
Straits	139	12	6
Australian	138	12	6
Eastern	141	15	0
Banca (nom.)	151	7	6
Off. av. cash, Nov.	132	18	10½
Do., 3 mths., Nov.	135	2	6
Do., Sttlmt., Nov.	132	17	10½

SPELTER.

	£	s.	d.
Ordinary	14	7	6
Remelted	13	5	0
Hard	11	10	0
Electro 99.9	16	15	0
English	15	5	0
India	13	15	0
Zinc dust	23	0	0
Zinc ashes	3	15	0
Off. aver., Nov.	14	0	10 5/16
Aver. spot, Nov.	13	16	10⅝

LEAD.

	£	s.	d.
Soft foreign ppt.	15	1	3
English	16	10	0
Off. average, Nov.	14	10	8 3/16
Average spot, Nov.	14	11	6½

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	10	0
Do., V.M. ex-whf.	25	10	0
Rods	32	0	0
Boiler plates			—
Battery plates			—

ANTIMONY.

	£	s.	d.
Special brand, Eng.	40	0	0
Chinese	28	0	0
Crude	20	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver (nom.)	19	0	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£6 12 6
45/50%	£10 0 0
75%	£15 5 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free, nominal	
Ferro-titanium—	
23/25% carbon-free	11¼d. lb.
Ferro-phosphorus, 20/25%	£19 0 0
Ferro-tungsten—	
80/85%	1/8½ lb. plus 20%
Tungsten metal powder—	
98/99%	1/11½ lb. plus 20%
Ferro-chrome—	
2/4% car.	£33 15 0
4/6% car.	£24 2 6
6/8% car.	£22 17 6
8/10% car.	£22 7 6
Ferro-chrome—	
Max. 2% car.	£34 0 0
Max. 1% car.	£40 0 0
Max. 0·70% car.	£51 2 6
70% carbon-free	11d. lb.
Nickel—99% (nom.)	£250 to £255
Ferro-cobalt	8/6 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	3/- lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export (nom.)	£ 9 0 0
Metallic manganese—	
94/96% carbon-free	1/6 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 3/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in.	3d. lb.
Do., under ⅜ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

South Wales—	£	s.	d.	£	s.	d.
Heavy steel				2	7	6
Bundled steel and shrngs.	1	17	6	to 2	6	6
Mixed iron and steel	2	2	6	to 2	3	6
Heavy cast iron				2	8	0
Good machinery for foundries	2	12	6	to 2	15	0
Cleveland—						
Heavy steel				2	2	6
Steel turnings				1	12	6
Cast-iron borings				1	6	0
Heavy forge				3	2	6
W.I. piling scrap				2	15	0
Cast-iron scrap	2	5	6	to 2	7	6
Midlands—						
Light cast-iron scrap				2	0	0
Heavy wrought				2	12	6
Steel turnings, f.o.r.				1	2	6
Scotland—						
Heavy steel				2	2	6
Ordinary cast iron				2	7	6
Engineers' turnings				1	10	0
Cast-iron borings				1	12	6
Wrought-iron piling				2	7	6
Heavy machinery				2	17	6

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	32	0	0
Brass	24	0	0
Lead (less usual draft)	13	0	0
Tea lead	10	0	0
Zinc	7	5	0
New aluminium cuttings	62	0	0
Braziery copper	30	0	0
Gunmetal	28	0	0
Hollow pewter	90	0	0
Shaped black pewter	70	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	65/6
Hematite M/Nos.	65/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	73/-
„ d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
„ No. 4 forge*	61/-
„ No. 3 fdry.*	66/-
Shrops basic	—
„ Cold blast, ord.	—
„ „ roll iron	—
Northants forge*	57/6
„ fdry. No. 3*	62/6
„ fdry. No. 1*	65/6
Derbyshire forge*	61/-
„ fdry. No. 3*	66/-
„ fdry. No. 1*	69/-
„ basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	72/-
„ No. 3	69/6
Hem. M/Nos. d/d	68/6
Sheffield (d/d district)—	
Derby forge	58/6
„ fdry. No. 3	63/6
Lincs forge	—
„ fdry. No. 3	63/6
E.C. hematite	77/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
„ fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	86/6 to 87/-
Clyde, No. 3	86/6 to 87/-
Monkland, No. 3	86/6 to 87/-
Summerlee, No. 3	86/6 to 87/-
Eglinton, No. 3	86/6 to 87/-
Gartsherrie, No. 3	86/6 to 87/-
Shotts, No. 3	86/6 to 87/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	9	15	0	to 10	5	0
Nut and bolt iron	8	7	6	to 8	12	6
Hoops	10	10	0	to 12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0	to 12	0	0
Bolts and nuts, ¾ in. × 4 in.				12	10	0
Steel—						
Plates, ship, etc.	8	15	0	to 8	17	6
Boiler plts.	8	15	0	to 9	15	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ¾ in. (Untested)		6	17	6 & up.		
Flats—8 in. wide and over				8	12	6
„ under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0	to 8	10	0
Fishplates				12	0	0
Hoops (Staffs)				9	10	0
Black sheets, 24g.	8	5	0	to 9	5	0
Galv. cor. shts.	9	0	0	to 9	10	0
Galv. flat sheets	9	10	0	to 10	0	0
Galv. fencing wire, 8g. plain				—		
Billets, soft	5	7	6	to 5	12	6
Billets, hard				6	12	6
Sheet bars	5	0	0	to 5	10	0
Tin bars				5	0	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	10½d.
Sheet to 10 w.g.	11½d
Wire	12⅜d.
Rods	11½d.
Tubes	16½d.
Castings	12½d.

Delivery 3 cwt. free.

10% phos. cop. £30 above B.S.
5% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.

C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.

Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	15.51
No. 2 foundry, Valley	16.00
No. 2 foundry, Birm.	12.00
Basic	16.76
Bessemer	18.26
Malleable	18.26
Grey forge	17.76
Ferro-mang. 80%	85.00
O.-h. rails, h'y, at mill	43.00
Billets	29.00
Sheet bars	29.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Skelp, sheared steel	1.60
Steel hoops	1.80
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	2.90
Wire nails	1.90
Plain wire	2.20
Barbed wire, galv.	2.55
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	20/- to 22/6
„ furnace	16/- to 17/6
Durham and Northumberland—	
„ foundry	15/- to 15/6
„ furnace	15/-
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	13/6 to 14/-
„	28×20 „	27/- to 28/-
„	20×10 „	20/3
„	18¾×14 „	14/9
C.W.	20×14 „	12/6 to 13/-
„	28×20 „	25/9
„	20×10 „	19/6
„	18¾×14 „	14/- to 14/3

SWEDISH CHARCOAL IRON & STEEL.

	£	s.	d.	£	s.	d.
Pig-iron	£6	0	0	to £7	0	0
Bars, hammered, basis	£16	10	0	to £17	0	0
Bars and nail-rods, rolled, basis	£15	17	6	to £16	5	0
Blooms	£10	0	0	to £12	0	0
Keg steel	£32	0	0	to £33	0	0
Faggot steel	£18	0	0	to £23	0	0
Bars and rods dead soft, st'l	£10	0	0	to £12	0	0

All per English ton, f.o.b. Gothenburg.

[Subject to an exchange basis of Kr. 18.16 to £1.]

TUBES AND FITTINGS.

Current Discounts.

	Tubes.	*Fittings.*
Gas	62½%	57½%
Water ..	58½%	52½%
Steam ..	55%	47½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

			£	s.	d.		
Nov.	26	..	32	5	0	dec.	30/-
,,	27	..	34	10	0	inc.	45/-
,,	30	..	36	2	6	,,	32/6
Dec.	1	..	37	17	6	,,	35/-
,,	2	..	37	7	6	dec.	10/-

Electrolytic Copper.

			£	s.	d.		
Nov.	26	..	38	0	0	dec.	20/-
,,	27	..	41	0	0	inc.	60/-
,,	30	..	41	0	0	No change	
Dec.	1	..	43	0	0	inc.	40/-
,,	2	..	43	0	0	No change	

Standard Tin (cash).

			£	s.	d.		
Nov.	26	..	135	5	0	dec.	37/6
,,	27	..	137	0	0	inc.	35/-
,,	30	..	136	5	0	dec.	15/-
Dec.	1	..	138	7	6	inc.	42/6
,,	2	..	137	5	0	dec.	22/6

Tin (English ingots).

			£	s.	d.		
Nov.	26	..	136	15	0	dec.	40/-
,,	27	..	138	10	0	inc.	35/-
,,	30	..	137	15	0	dec.	15/-
Dec.	1	..	140	0	0	inc.	45/-
,,	2	..	138	15	0	dec.	25/-

Zinc Sheets (English).

			£	s.	d.		
Nov.	26	..	24	0	0	No change	
,,	27	..	24	0	0	,,	,,
,,	30	..	24	0	0	,,	,,
Dec.	1	..	24	10	0	inc.	10/-
,,	2	..	24	10	0	No change	

Spelter (ordinary).

			£	s.	d.		
Nov.	26	..	13	13	9	dec.	6/3
,,	27	..	13	17	6	inc.	3/9
,,	30	..	14	0	0	,,	2/6
Dec.	1	..	14	10	0	,,	10/-
,,	2	..	14	7	6	dec.	2/6

Lead (English).

			£	s.	d.		
Nov.	26	..	16	0	0	dec.	5/-
,,	27	..	16	0	0	No change	
,,	30	..	16	5	0	inc.	5/-
Dec.	1	..	16	15	0	,,	10/-
,,	2	..	16	10	0	dec.	5/-

AVERAGE MONTHLY PRICES OF STEEL SHIP PLATES (NORTH OF ENGLAND).

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1896	5 0 0	5 0 0	5 2 6	5 2 6	5 2 6	5 0 0	5 0 0	5 0 0	5 0 0	5 2 6	5 10 0	5 10 0	5 2 6
1897	5 10 0	5 10 0	5 10 0	5 7 6	5 2 6	5 2 6	5 0 0	5 0 0	5 0 0	5 0 0	5 7 6	5 10 0	5 5 5
1898	5 10 0	5 8 9	5 8 9	5 10 0	5 16 2	5 18 9	5 17 6	6 0 0	6 2 6	6 5 0	6 10 0	6 15 0	5 18 6½
1899	6 15 0	7 0 0	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 12 6	7 12 6	7 12 6	7 12 6	8 0 0	7 6 5½
1900	8 0 0	8 0 0	8 2 6	8 5 0	8 7 6	8 7 6	8 7 6	8 0 0	8 0 0	8 0 0	7 10 0	7 0 0	8 0 0
1901	6 15 0	6 15 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 5 0	6 7 6	6 5 0	6 0 0	6 0 0	6 4 4
1902	5 17 6	5 12 6	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 10 0	5 14 7½
1903	5 10 0	5 10 0	5 15 0	6 0 0	6 0 0	6 0 0	5 12 0	5 12 6	5 12 6	5 12 6	5 12 6	5 10 0	5 13 11
1904	5 7 6	5 10 0	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 11 10
1905	5 15 0	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	6 0 0	6 10 0	7 0 0	7 0 0	6 2 3½
1906	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 10 0	7 0 10½
1907	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 0 0	7 0 0	7 8 4
1908	6 10 0	6 10 0	6 10 0	6 5 0	6 5 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 3 9
1909	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	5 15 0	5 15 0	5 15 0	6 0 0	6 0 0	6 0 0	6 0 0	5 18 9
1910	6 5 0	6 5 0	6 7 6	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 2
1911	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 18 4	6 15 3½
1912	7 3 9	7 5 0	7 5 0	7 12 6	7 15 0	7 15 0	7 15 0	8 0 0	8 0 0	8 0 0	8 2 0	8 5 0	7 14 10
1913	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	7 19 0	7 15 0	7 3 0	6 15 0	6 10 0	7 16 5½
1914	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 0 0	6 0 0	7 0 0	7 5 0	7 5 0	7 6 3	7 10 0	6 14 8¼
1915	8 0 0	8 10 0	9 0 0	9 10 0	9 10 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 5 0	11 0 0	9 12 11
1916	11 7 6	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 9 2
1917	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0
1918	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0
1919	11 10 0	14 0 0	14 0 0	14 0 0	17 0 0	17 7 6	17 15 0	18 5 0	18 5 0	18 5 0	19 12 6	21 5 0	16 15 5
1920	22 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	24 0 0	24 10 0	24 5 0	24 5 0	23 13 4
1921	23 5 0	22 10 0	20 4 0	19 0 0	19 0 0	17 0 0	15 0 0	14 15 0	13 12 0	12 5 0	10 10 0	10 10 0	16 9 3
1922	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 4 0	10 0 0	9 7 6	9 4 0	9 5 0	9 5 0	9 5 0	9 18 4½
1923	9 7 6	9 15 0	10 5 0	10 10 0	10 10 0	10 10 0	9 18 9	9 17 6	9 17 6	9 17 6	9 18 6	10 6 10½	10 1 2½
1924	10 1 6	9 18 1½	9 17 6	9 17 6	9 17 6	9 19 4½	10 5 0	10 5 0	10 5 0	9 19 0	9 15 0	9 15 0	9 19 7½
1925	9 14 0	9 10 0	9 10 0	9 1 3	9 0 0	9 0 0	8 17 0	8 13 1½	8 7 6	8 5 6	7 16 3	7 14 3	8 15 8½
1926	7 12 2½	7 12 6	7 12 6	7 14 4½	7 15 0	7 16 10½	8 2 6	8 2 6	8 4 0	8 12 6	8 12 6	8 16 3	8 1 1½
1927	8 17 6	8 17 6	8 11 6	8 7 6	8 6 3	8 5 0	8 5 0	8 3 9	8 2 6	8 2 6	8 5 0	8 5 0	8 7 5
1928	8 2 6	8 5 0	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 6 10½
1929	8 7 6	8 7 6	8 7 6	8 7 6	8 10 6	8 12 6	8 12 6	8 12 6	8 12 6	8 12 6	8 12 6	8 13 9	8 10 9½
1930	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1931	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	—	—

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EMPLOYMENT REGISTER.

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Any Member, Associate Member or Associate of the Institute of British Foundrymen who desires his qualifications to be inserted in the column must forward to the General Secretary of the Institute the following information:—(a) Name and address; (b) name of present employer (or last employer if unemployed); (c) brief particulars of qualifications, experience, and type of position required. The name will not be disclosed until the candidate is in communication with a prospective employer. Announcements will be inserted in two successive issues, unless announcers' requirements have been met with in the meantime.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

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PETER—WITH ONE EXCEPTION

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Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed.

There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d. a year to you. Send Peter and his handicapped pals 3d. for every year you've had it. Now, please, in case it slips your memory. Good idea?

The Chairman,

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